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U. S. DEPARTMENT OF AGRICULTURE

DIVISION OF CHEMISTRY

BULLETIN No. 29

RECORD

OF

EXPERIMENTS WITH SORGHUM

IN

1890

BY

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PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE

WASHINGTON

GOVERNMENT PRINTING OFFICE

1891

PREFATORY NOTE.

MARCH 6, 1891.

SIR: I have the honor to submit for your approval the manuscript of Bulletin No. 29.

In this bulletin are collected such data relating to the production of sugar from sorghum as have been obtained in the experiments of the Department during the season of 1890. These experiments were conducted chiefly in the States of Kansas, Maryland, and Mississippi.

Respectfully,

H. W. WILEY,
Chemist.

HON. J. M. RUSK,
Secretary of Agriculture.

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EXPERIMENTS WITH SORGHUM IN 1890.

STUDIES ON THE SEPARATION OF SUGAR FROM SORGHUM JUICES.

For many years attempts have been made by the division to secure a more perfect separation of the sugar from the non-sugars in sorghum juices. Extensive practical experiments were made in this direction at Fort Scott, Kansas, in 1886, in the practical application of the process of carbonatation.

This process consists in the addition to the mill or diffusion juices of large quantities of lime, from 1.5 per cent. to 3 per cent. of the weight of the juice, according to the amount of impurities present. The lime is then precipitated by blowing through the liquid a current of carbonic acid derived from a limekiln or coke furnace, or even from the chimneys of the boiler furnaces. The result of this process was entirely successful in respect of the yield of sugar, but on account of the blackening of the molasses, which was at that time a valuable by-product, it met with no favor from sorghum sugar manufacturers, but on the contrary was condemned by them as being unsuitable for the purpose.

Subsequently extensive laboratory experiments were made looking to the precipitation of the crystallizable sugar in the juices as sucrates of lime. The process employed in the Steffen method of separating sugar from beet-root molasses was the one tried for this purpose. While these experiments were successful in separating the crystallizable sugars in the form of a precipitate, they were not wholly so in securing a separation from the non-sugars, the greater part of which were also thrown down as lime compounds or carried down mechanically with the precipitated sugar. This process was, therefore, abandoned as not being practical.

The destruction of the reducing sugars or glucoses present by boiling with excess of quicklime was next tried. This process was entirely successful in so far as destroying the glucoses was concerned, but it had no effect whatever upon the other carbohydrates, of an amorphous nature present in the juices. Inasmuch as the glucoses exert the least unfavorable influence of the non-sugars present in the juices the process was at once seen to be inapplicable from a practical point of view. The experience of the Department, and of manufactur-

ers of sugar, has shown that the reducing sugars known generally under the term of glucoses exercise a much less influence in preventing the crystallization of the sugars than was formerly supposed. In fact, it is supposed that could all other disturbing influences be removed, the glucose might not prove very objectionable in securing an almost complete crystallization of the sucrose present in the juices. It would furnish a mother liquor in which the crystallizable sugar would be highly insoluble and from which it would easily separate. Having abandoned, therefore, the methods of separation above noted, there remained to be studied some process which would separate as nearly as possible the gummy amorphous bodies from the juices without precipitating the sugar. The property of alcohol to produce precipitation in sorghum juice was made use of in the further study of this problem. On account, however, of the large amount of alcohol which would be required to treat the juices in their natural state, or as they come from the diffusion battery, it was decided to apply the process at a later period of manufacture.

In order to carry out this idea the juices of sorghum were treated precisely in the manner in which they are ordinarily in a sugar factory. The natural acidity of the juices was carefully neutralized with lime and the whole raised to the boiling point. The scums which were formed were carefully removed and the juice boiled in an open dish until all greenish scums and coagulated matters were separated.

The inversion of sugar which takes place during the boiling, which lasts only a few minutes, was not noteworthy. The juices were next concentrated in vacuo until they reached a density of 45° to 50° Brix. After cooling, the sirup thus formed was mixed with an equal volume of 95 per cent. alcohol, which was sufficient to produce a complete precipitation of the gummy amorphous matters and other bodies insoluble in alcohol of that strength. These matters were separated by passing through a filter press, forming a hard, firm cake, easily separated from the filter cloth. The filtered sirup was limpid and of an exceptionally pleasant flavor. Evaporating in vacuo after removal of the alcohol, it readily crystallized during evaporation, forming a massecuite of good grain and absolutely free from gum and capable of being treated most easily in a centrifugal.

From very poor sorghum juices from immature cane, having a purity of only 60, a most excellent article of massecuite and sugar was made by the above process.

In regard to the quantity of matters separated by alcohol, some determinations were made with the following results:

Percentage of gum secured by alcohol—

Experiment 1	2.08
Experiment 2	1.88
Mean	1.98

The juices from which these separations were made contained about 16 per cent. of solid matters; thus the percentage of matters secured by alcohol on the whole amount of solid matters present was 12.5.

It is seen from the above data that from each 100 pounds of sorghum juice about 2 pounds of melassigenic substances can be separated.

The difficulties which have been encountered in manufacturing sugar from sorghum juices have been largely due to the presence of these gums. Their removal, therefore, if it can be accomplished on a manufacturing basis, would at once place sorghum in a high rank as a sugar-producing plant.

The alcohol which is used in precipitation can be almost wholly recovered by subsequent distillation. Our experiments show that the total loss need not exceed 5 or, at most, 10 per cent. of the quantity of alcohol used. One of the most encouraging and at the same time least expected results of the work has been the demonstration of the fact that the gum separated in the manner above described is completely fermentable, yielding almost one-half its weight in alcohol. It thus appears that from the gums themselves a sufficient amount of alcohol may possibly be derived to supply the whole waste of alcohol which would take place in the process of manufacture. Any additional quantities of alcohol which might be needed could be easily obtained from the molasses after the extraction of all the crystallizable sugar. In other words, the process which has been demonstrated as thoroughly practical in the laboratory, so far as can be foreseen for the operation of an actual trial on a manufacturing scale, is capable of being conducted with economy, and a proper stock of alcohol once being provided the wastage therein in the process of manufacture could be wholly, or in part at least, supplied by the refuse matter which otherwise would be manufacturing waste.

Experiments were also made to determine the quantity of alcohol necessary to precipitate the total gum and other matters and also the strength of the alcohol required with the following result:

SORGHUM SIRUP, OF 44° BRIX AT 60° F.

The quantities of ethyl and methyl alcohol required to precipitate the amorphous matters from a given volume of sorghum sirup are given in the following table:

Series of experiments.

[Comparison showing quantities of alcohol of 70, 80, and 90 per cent, and of methyl alcohol (crude) necessary for 25 cubic centimeters of sirup, of 44° Brix at 60° F.]

	70 per cent.	80 per cent.	90 per cent.	Methyl alcohol.
	cc	*cc*	*cc*	*cc*
Chief precipitation of amorphous bodies	20	15	10	12
Total precipitation of those bodies	35	25	20	20

The portion of the amorphous bodies which is soluble in water becomes, in part, redissolved before filtration when precipitated with 70, and rather less so with 80 per cent. alcohol.

The separation of the amorphous bodies can be attained on the manufacturing scale with 80 per cent alcohol by the application of 1 volume of alcohol to 1 volume of sirup of 44° Brix.

In order to illustrate the practical application of the method on a manufacturing scale in the manufacture of sorghum sugar the following theoretical data are given:

A normal sorghum juice may contain at 18° Brix 12 per cent of sugar; a normal sorghum sirup may contain at 44° Brix 29.33 per cent of sugar, which is equal to 29,330 pounds of sugar in 10,000 gallons of sirup. Of this, 29,330 pounds (from 7,280 to 13,000 pounds), or about an average of 10,000, has been obtained by the methods of manufacture in use.

By the use of alcohol for the removal of the amorphous bodies which prevent the crystallization of the sugar, the *minimum* per cent of sugar, which, after this process would be obtained, may be put at 80 per cent (87 per cent is usually computed from pure juices), or 23,464 pounds.

10,000 pounds, at 4 cents		$400
23,464 pounds, at 4 cents	$938	
Cost of alcohol	84	
		854
Value of product, usual method	400	
Value of product, alcohol method	854	
A gain of		454

In this estimate the material from which the alcohol is made is not regarded as of any value, since it otherwise would be wasted. If the molasses be used as a source of alcohol, then the item for the cost thereof must be increased. It is not expected that these purely theoretical figures can be reached in actual practice; but they show that a largely increased yield over that of the ordinary method may certainly be obtained. It appears, in fact, that for each ton of sorghum cane entering into manufacture, about 20 pounds of precipitate by alcohol may be obtained. This precipitate is of the highest melassigenic nature. Its removal certainly will secure an increase in the yield of sugar of from two to three times its weight, *i. e.*, of from 40 to 60 pounds. It is believed that not more than 2 or 3 gallons of alcohol will be lost for each ton of cane worked, and this would still leave a profit of fully $1 per ton greater than could be obtained by the methods now in use. Even so small a profit as this would help to place the sorghum-sugar industry on a sound financial basis.

On account of the ease with which a heavy sirup can be preserved it has also been thought possible that during the manufacturing season the whole apparatus of the factory could be directed to making sirup alone which could be preserved and worked into sugar subsequently.

Inasmuch as it is highly important, in working a sorghum crop, to have it taken off in as short a time as possible, any scheme which will tend to simplify the operation during the harvesting season is worthy of consideration.

It is true that the storage of a whole crop of sirup would require considerable room and the cost of tanks or cellars in which it is to be held would be an item which could not be neglected. However, it must not be forgotten that by the storage system the machinery of the factory could be operated during a much longer period. For instance, it is well known that the harvesting operations and the manufacture of sugar must be chiefly conducted during the months of September and October. The manufacture of sirup into sugar, however, could be continued through the winter months, or if they were found too cold, the work could be safely left until the beginning of spring, when the factory could be again set in operation.

The whole of the apparatus for manufacturing the alcohol and for treating the sirup therewith could, therefore, be built on a much smaller scale than if it were necessary to treat the sirup as soon as it was manufactured during the months of September and October. With the sirup already made and stored in cisterns, a very small force would be sufficient to convert the whole of it into sugar and at a very small expense. It would thus be possible for one factory to take care of a much larger crop of cane than it could possibly do were the whole of the manufacturing operations to be conducted at once.

The sirup as made and as it passes into cisterns could be subjected to the influence of sulphurous acid or some other anti-ferment which would be sufficient to preserve it perfectly from fermentation, even if there were danger of such a decomposition without any antiseptic treatment.

The storage capacity of a factory which would work 20,000 tons of sorghum cane will be seen from a perusal of the following data: Assuming 20,000 tons chips and 10 per cent marc we have, 11,782,030 pounds sirup at 55° Brix, raised from 18° Brix=volume of 149,938 cubic feet, requiring a cistern 20 by 86.5 by 86.5 feet. At 75° Brix= 8,640,380 pounds=volume of 100,213 cubic feet, requiring a cistern 20 by 75 by 75 feet.

In the event of boiling from 55° to 75° Brix, the water evaporated will be, on 20,000 tons of cane chips, 3,141,650 pounds, or 377,150 gallons. Basing calculations on Yaryan's figures, the coal consumption (at 8½ pounds water per pound coal) in again evaporating from 55° to 75° Brix will be 369,600 pounds, using live steam altogether, as would be necessary in the contemplated division of the season. Hence the loss occasioned by boiling to 75° Brix as a means of preserving and subsequent dilution would be 133,261+369,600=502,861÷2,240=225 tons, plus incidental losses, radiation, time, etc.

Placing the value of coal at $4 per ton, which is rather a high average,

it is seen that the total additional expense, so far as fuel is concerned, involved in manufacturing the sugar after the harvesting of the crop, would be only about $900 a year, a very insignificant item when compared with the value of the time gained.

EXPERIMENTS WITH MOLASSES.

Trials of molasses from the Parkinson Sugar Company, of Fort Scott, Kansas, have also been made. In treating molasses by the alcohol method the most discouraging fact presented is that the total precipitate obtained does not bear the ratio to that obtained from the fresh sirups which would be indicated by their respective degrees of concentration. If a fresh sirup should yield a precipitate which is approximately 2 per cent of the weight of the normal juice, the molasses *a priori* would give similar results. Instead of this, however, the weight of the precipitate obtained from the molasses was in every case much less than was theoretically expected. It was anticipated that the molasses would yield a precipitate corresponding to from 6 to 8 per cent of its weight. There was really obtained only about half this quantity. This would seem to indicate that the amorphous bodies had undergone some hydrolytic fission during long-continued boiling and standing in tanks, and that the resulting bodies were more soluble in alcohol than were the originals. These experiments indicate that even the storage of sirups, as indicated above, might be attended with serious results threatening the success of the process. Further experiment is therefore necessary to determine the practicability of the processes proposed.

COMPOSITION OF THE MOLASSES AS AFFECTED BY TREATMENT WITH ALCOHOL.

Two samples of sorghum molasses resulting from the manufacture of first sugars at Fort Scott in 1890 were submitted separately to analysis and alcohol treatment. The results follow:

	Before treatment.		After treatment.	
	First sample.	Second sample.	First sample.	Second sample.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Ash	5.30	5.19	4.99	2.84
Water	21.00	24.54	19.26	17.90
Glucose	21.70	19.44	22.69	23.09
Sucrose	42.30	43.61	48.96	51.62
Undetermined	5.90	3.53	3.78	4.55
Alcohol precipitate	3.80	3.69	.....	.....
Purity	53.55	57.79	60.64	62.88

The increase in the purity coefficient in both samples after treatment with alcohol is very gratifying.

The resulting sirups from both samples were placed together in a warm room and yielded a large crop of crystals, but the pounds of sugar thus obtained per gallon of molasses used could not be directly deter-

mined. The general result of the experiments shows that the proper time for the application of the alcohol is to the sirup of about 50° Brix as soon as it is prepared.

If, however, it be found impracticable to treat the whole crop as it is manufactured by this method, it may prove economical to store a part of it as has already been indicated, or to manufacture a part of it by the processes now in use, leaving the molasses for subsequent treatment.

In order that this method of production of sugar may become possible, it will be necessary for the revenue laws to be changed so as to allow the preparation of the alcohol used in the process to be carried on without tax. This could be easily done without any danger of defrauding the revenue. The alcohol could be made under bond, given by the sugar manufacturer, that it should be used only for the purpose of separating the gummy matters from the sorghum juice, and should in no case enter commerce for any purpose whatever. In making this alcohol the manufacturer should be allowed to erect such apparatus as may be necessary, and this apparatus could be under the direct inspection of revenue officers in order that they might be able to see that the conditions of bond were faithfully carried out.

It is earnestly recommended that the revenue laws be so amended as to allow a trial of this process by the sorghum-sugar makers of the country. If this can not be done without a further illustration, the law, at least, should be so adjusted as to permit the Department to make an experiment on a small scale with this method in connection with the work which it is now doing in the experimental station for the improvement of sorghum cane and the manufacture of sugar therefrom.*

It is important also that the Department be empowered, by a special grant, to carry out these experiments in a practical way. From the best estimates which are now at my disposal I should say that a grant of $25,000 would be entirely sufficient to subject this process to an experimental trial. The magnitude of the interest involved is so great that it is hoped that no objection will be made to this experiment.

Not only is the increase in the output of sugar from sorghum cane to be taken into consideration, but also the improvement in the quality of the product. The sugar will be of a finer grade and much more easily separated from the molasses. The molasses instead of being, as it is now, a waste product scarcely marketable, and in many cases only fit for cattle food, will be suitable for table use and especially for mixing, in case compound sirups are desired. The flavor of both the sugar and the molasses produced is of the finest quality and of such a nature as to render it difficult to believe that it could have been made from sorghum, which, under ordinary circumstances, affords a molasses which is unpalatable.

* These recommendations were favorably considered by Congress and the permission to use alcohol in bond was granted.

This process having been outlined above in such a way as to indicate its true character, it is hoped it may be given to the sugar manufacturers of the country without interference from any patents which may attempt to secure its provisions for private benefit. As our patent laws now stand any process which has not been in use for two years may be covered by letters patent, but in this case it must be distinctly proved that the inventor is, as he claims in his application, the true discoverer of the process. This process having been discovered and operated by the Chemical Division of this Department, is unpatentable, except by the Department for the common use of the people.

THE COMPOSITION OF THE BODIES PRECIPITATED BY ALCOHOL FROM SORGHUM SIRUPS.

The data following were obtained by an investigation undertaken with the collaboration of Mr. Walter Maxwell, who had charge of the laboratory work.

It has often been a matter of surprise that sorghum juices with a promising polarization yielded quantities of sugar sadly disappointing. Since the work of the Department relating to sugar production was for many years, in accordance with the acts of Congress, devoted wholly to experiments relating to sugar manufacture, it was not found possible to make a thorough study of the character and constitution of the various melassigenes which were supposed to be present. For the past two years, however, the work of the Department, and of the chemical division in particular, has been more and more directed to the agricultural and chemical properties of the sorghum plant in all stages of its growth, beginning with the seed and ending with the natural plant. Portions of the work have already been published in a paper by a member of the division in the Proceedings of the Society for the Promotion of Agricultural Science for 1889, and in a joint paper published in the American Chemical Journal, Vol. 12, No. 3. The following contribution contains the results of the preliminary investigations of the mucilaginous and carbohydrate melassigenes, in which it is believed that each important one has been separated and wholly or in part identified. When the great number of these amorphous and dismorphous bodies is considered, and the aggregate large percentage of sorghum melada which they form is taken into consideration, it is no longer a matter of surprise that the yield of sorghum sugar is so small, but rather so large.

The purely chemical problems involved are even of greater interest than the economic ones, and it is to these that the present paper is devoted.

The question of the total optical effect which these various bodies

exert on the ray of polarized light is reserved for a more intimate future study. Some of these bodies are undoubtedly levogyres, such as the nitrogenous compounds, while among the dextrogyres are to be reckoned most of the carbohydrate compounds which have been separated. We are, therefore, at the present time, unable to say that the direct, or even indirect, polariscopic reading of a sorghum juice correctly indicates the true content of sucrose therein.

The subject of the non-crystallizable matters present in sorghum molasses was taken up by Dr. Collier and C. Richardson, and the results of their investigation are given in the Report of the Commissioner of Agriculture for 1878, page 107. Those results appear to be as follows:

The gum was precipitated out of the water solution of the molasses with 95 per cent. alcohol. The gum was washed with alcohol, and, after evaporating off the alcohol, was dissolved in a little water and purified with boneblack. The solution with alcohol gave a snow-white precipitate, which, after washing with alcohol and ether, could not be dried over sulphuric acid without drying up into a black, oxidized mass. "The gum so prepared is a white powder, easily oxidixing on exposure to the air and turning black. It is somewhat deliquescent. Under 80 per cent. alcohol it may be preserved indefinitely as a snow-white substance." It was further observed that the body, which was soluble in water, gave many of the reactions characteristic of mucilages; but "with Fehling's solution it gave a flocky precipitate, reducing only slightly," which latter was "probably owing to a trace of sugar in the gum."

The method pursued in the present investigations of the sorghum gummy, mucilaginous and other amorphous bodies, was as follows:

A large volume of the molasses was dissolved in the same volume of water and placed in large precipitating jars. To the water solution was added an alcohol of from 98 to 99 per cent., and until the precipitation of matters was no longer observed. The total precipitate, which could contain nitrogenous and non-nitrogenous bodies, was of great volume, and had a dark gray, mucilaginous appearance. After standing some hours, the bulk of the liquid was removed with a siphon, and the precipitate separated from the remaining liquid by filtering through cloth. The total precipitate was placed in a large jar and saturated with strong alcohol, standing 2 days. The precipitate was again separated by filtering, washed out with alcohol, and placed on the steam bath at as low a temperaure as the alcohol would evaporate.

The *original precipitate*, obtained by the process that has been described, was examined in the following way:

In order that the solvents could act as quickly as possible upon the precipitate, it was divided into portions, and saturated with a large volume of water, first in the cold and afterwards at a temperature of about 65° C.

The precipitate, or total matters, was suspended in water, and fre-

quently stirred, for as many hours as it was sure that no change could be caused by the water in the nitrogenous matters. The bodies soluble in water were separated by filtering and the residue of the original precipitate washed out with water.

FERMENTATION OF THE CRUDE PRECIPITATE.

The carbohydrate bodies contained in the crude precipitate appear to be completely fermentable. From 420 grammes of the water free material there were obtained 164 grammes of absolute alcohol. Previous hydrolysis of the carbohydrate bodies does not appear to increase the yield of alcohol.

From 450 grammes of the crude material boiled for 3 hours with 1 per cent. H_2SO_4 there were obtained only 152 grammes of absolute alcohol. The purified gums soluble in water yield a full theoretical quantity of alcohol without previous hydrolysis.

OCCURRENCE OF PENTAGLUCOSE.

The alcohol precipitate, tested by the method of Stone, yielded considerable quantities of furfurol, indicating the presence of a pentaglucose.

It was stated in the work already referred to, and contained in the Report of the Commissioner of Agriculture for 1878, that the original precipitate was soluble "in a little water." In the present investigation it was found that only a part of the original precipitate was soluble in water after saturation for several hours, and that one-third remained as an undissolved residue. From a physiological view such a result was to be expected. In consequence of the observation concerning the solubility in water, it was resolved to study the total matters contained in the original precipitate according to the order of their solubilities, and in the sequence expressing—

1. The series soluble in water.
2. The series soluble in sulphuric acid (dilute).
3. The series soluble in sodic hydrate (dilute).
4. The series soluble in cuprammonium.

1. *Bodies soluble in water.*—In the preliminary investigation it was seen that only about two-thirds of the original precipitate was soluble in water. The "water soluble part," after filtering and washing out of the insoluble residue, was treated with bone-black, which made the brown colored solution a bright yellow, and condensed to a small volume. After cooling, alcohol of 99 per cent concentration was added to the solution until the precipitable matters were totally thrown out. The precipitate was brought upon a filter and washed out with strong alcohol, when it was white in appearance in comparison with the "original precipitate." In order, however, to obtain the body, or mixture of bodies, free from coloring and mineral matters, the precipitate was re-

dissolved in water, and re-precipitated with alcohol six times, and, after the final filtration, pressed between filter paper to remove the excess of moisture and afterwards dried over H_2SO_4 in a desiccator, by which process an almost pure white, amorphous body, or mixture of bodies, was obtained.

In proceeding to examine the properties of the portion of the original precipitate soluble in water certain indications are observable in the chemical behavior with the following reagents:

1. Neutral or acid iodine = purple coloration.
2. Basic plumbic acetate = white precipitate.
3. Sodic acetate = no action.
4. Magnesic sulphate = slight turbidity.
5. Sodic sulphate = no action.
6. Ammonic sulphate = no action.
7. Sodium phosphate = heavy white precipitate.
8. Ammonic phosphate = heavy white precipitate.
9. Phosphotungstic acid = heavy white precipitate.
10. Fehlings' solution:
    Before hydration = no action.
    After hydration = strong reduction.

The sensibility of the body to the color action of iodine may indicate the presence of a modification of starch, or of a mucilage; that property, however, does not show which of the two is present, but rather that both may be.

The lead acetate, as was observed, threw down out of the aqueous solution a heavy white precipitate, which could include the mucilaginous, albuminous, and other matters. After the precipitation with lead acetate and the removal of the excess of lead from the filtrate, the latter, on being concentrated, gave a further precipitate with a stong alcohol, indicating that, in addition to the mucilaginous matters separable by lead acetate, one or more of certain amorphous carbohydrates may be present, which bodies, although insensible to lead acetate in aqueous solution (excepting in instances where carbohydrates may be in combination with a gum or mucilage), are precipitated by strong alcohol.

The greater part of the bodies, however, is separated out of the aqueous solution with lead acetate, indicating that a mucilage or gum or several modifications of such bodies compose the chief weight of the portion of the original precipitate which is soluble in water.

The aqueous solution of the bodies was studied in its behavior with solutions of the neutral sulphate and phosphate salts already specified, and in the light thrown upon the subject by the researches of Dr. Julius Pohl (See Zeitschrift für physiologische Chemie). It has already been observed that the aqueous solution gave no precipitates with solutions of Na, NH_4, and Mg sulphates, excepting the latter, when a turbidity was seen. With solutions of Na and NH_4 phosphates heavy and stable precipitates were obtained. It has been found by Dr. Pohl that the tragacanth, althea, linseed, and cydonia mucilages are precipitated by saturating their aqueous solutions with sulphate of ammonia. The

aqueous solution of the present body is wholly insensible to NH_4 and Na sulphates, consequently it has no identity with the above-cited mucilages. Carragheen and salep mucilages are precipitated out of aqueous solution by both the sulphate and phosphate of ammonia. The present body, whilst precipitated by NH_4 phosphate, is wholly indifferent to NH_4 sulphate. It thus appears that the mucilage or gum body under consideration indicates some approach to the carragheen and salep mucilages in its action with phosphate salts, but it is distinguished from the known mucilages in its behavior with the neutral sulphates. It was observed that Mg sulphate gave a turbidity when added to the solution of the body; that salt, under some conditions, will precipitate soluble starch, galactins, dextrins, etc. In a treatment of the water soluble matters, separated from the juices of the sorghum cane, with Mg sulphate an amorphous white body was obtained whose properties have not been further examined for want of material. It is possible that the turbidity caused by the Mg sulphate may have been due to some small portion of the body observed, in another place, in cane juices having remained unchanged in the molasses made from the cane. It thus appears that the main part of the bodies separated from the original precipitate in aqueous solution is composed of a mucilage or gum having a characteristic agreement with other known mucilages by its sensibility to iodine and to boiling with dilute neutral acids, after which latter treatment its products reduce an alkali-copper solution. It is, on the other hand, distinguished from other mucilages by its insensibility to saturated solutions of neutral sulphate salts.

It was likewise observed that the aqueous solution of the bodies gave a heavy white precipitate with phosphotungstic acid. That reagent would remove from the solution the mucilaginous matters thrown out by the Pb acetate and also any alkaloidal principles if present. After treatment of a portion of the aqueous solution with phosphotungstic acid, and neutralizing the filtrate with barium, the filtrate had no action on Fehlings' solution; but after boiling the solution with hydrochloric acid it reduced the copper solution abundantly. The action of dilute acids upon the muclilages produces sugars capable of reducing copper solutions; in this case the mucilage bodies were previously removed by the phosphotungstic acid, consequently the body or bodies remaining in the solution, which, after inversion, acted upon the Fehlings' solution, are amorphous carbohydrates, which bodies, after the previous separation of the mucilaginous and other matters by Pb acetate, have already been stated to be thrown out of solution with strong alcohol.

It was considered of interest also to study the optical disturbances produced in a solution of sorghum molasses by the successive removal of the nitrogenous bases and the residual substances insoluble in alcohol.

For this purpose a quantity of molasses was diluted with an equal bulk of water and treated with basic subacetate of lead in slight excess.

The excess of lead was removed by the cautious addition of dilute H_2SO_4 until no further precipitation took place. Only a trace of acid being used in excess it was not found necessary to remove it with barium carbonate. The total volume of 100 cubic centimetres of the first filtrate after this treatment was found to be 106.1 cubic centimetres. The polarization, in sugar degrees, of this solution was 64°.99.; 20 cubic centimetres of the above liquor were treated with phosphotungstic acid until no further precipitation took place and the volume was made up to 50 cubic centimetres. This solution polarized 25°.40, which, calculated to original volume, equals 67°.37. Twenty-five cubic centimetres of the phosphotungstic filtrate were made up to 50 cubic centimetres with 96 per cent alcohol and filtered.

The filtrate polarized	13° .60
Or on original substance	72° .15

The several polarizations of the different liquors, calculated to the original solutions, are given together below:

Solution clarified by lead	64° .99
After treatment with $H_{11}PW_{10}O_{38}$	67° .37
After treatment with $H_{11}PW_{10}O_{38}$ and alcohol	72° .15

The experiments were repeated on a somewhat more concentrated solution of molasses, and the summary of results is as follows:

	Polarization.
After treatment with lead	83°.92
After treatment with lead and $H_{11}PW_{10}O_{38}$	84°.54
After treatment with lead, PW_{10}, and alcohol	87°.93

The results clearly indicate that the removal by phosphotungstic acid of the nitrogenous rest frees the solution from a levogyrous body.

The marked increase in dextrogyrous power shown on the treatment of the solution with alcohol however is doubtless due in part to the depressing effect of alcohol on the rotatory power of the levulose present. The body, precipitated by alcohol, is in appearance dextrinoid, and the logical supposition would be that the dextrogyrous property of the solution would be diminished, which in fact is not the case. The notable depression of rotatory power produced in levulose solutions by alcohol has been mentioned by Herzfeld (Berichte 19, 398).

Character of the alcohol precipitate.—The precipitate obtained by alcohol in the above experiments is undoubtedly of the same composition as that of the dysmorphus carbohydrates obtained by the method of separation at first followed. It is, however, thus obtained directly after the removal of all the organic acids and mucilaginous bodies or gums. Purified by reprecipitation and dried at ordinary temperatures over H_2SO_4 in vacuo, it was found difficultly soluble in water and doubtless consists of two bodies differing in their solubilities in water.

A little over half a gramme of it (0.5316 gramme) gave in 25 cubic

centimetres in a 600-millimetre tube an angular rotation of 3°.38=1°.13 for a 200-millimetre tube, or 0°.283 for 0.5316 grammes in 100 cubic centimetres. Then

$$(a)_D = \frac{100 \times 0.283}{2 \times 0.5316} = 26°.6.$$

This body is, therefore, not any of the ordinarily occurring sugars, but is probably composed of an optically inactive body with a small proportion of a dextrinoid or a dextrogyrous body resembling quercite in optical properties. It was without action on alkaline copper, but after hydration with H_2SO_4 was strongly reductive.

The conclusion is thus indicated that that portion of the original precipitate which was soluble in water is composed of a mucilage having the characteristic properties given, and of a carbohydrate or carbohydrates, which are without action upon the alkali-copper solution before boiling with an acid, and which, after inversion, are strongly reducing bodies. These carbohydrates have yet to be identified. They have only a slight action on polarized light. Their classification is reserved for subsequent work.

Bodies soluble in dilute sulphuric acid.—After the separation of the bodies soluble in water the residue of the original precipitate was submitted to the action of dilute sulphuric acid. The residue was heated upon the steam bath with a 1.5 per cent. acid for a period of 10 hours at a temperature of 85° C. After filtering the still undissolved residue was washed out and the washings added to the solution. The H_2SO_4 solution was neutralized with $BaCO_3$ and evaporated to a sirup. The sirup was extracted with 95 per cent. and 85 per cent. alcohols consecutively. A part of the sirup was taken up by the alcohol; a large part, however, was coagulated and remained behind after extracting for 2 hours under a condenser. In consequence of the behavior of the sirup with alcohol the portion of the original precipitate soluble in dilute H_2SO_4 must be considered in two parts:

(*a*) Part of sirup soluble in alcohol; (*b*) part of sirup coagulated by alcohol.

(*a*) The part taken up by alcohol was evaporated to drive off the alcohol and the residue taken up in water and treated with boneblack. The water solution was concentrated, brought into a stoppered bottle and five volumes of strong alcohol added, and the bottle placed in a freezing mixture of ice and salt. After repeated renewals of freezing the liquid became quite clear. A heavy sirup, having the appearance of uncrystallized sugar, precipitated to the bottom of the bottle, and a crystallized body, much resembling dextrose in appearance, separated out. After pouring off the alcohol the crystallized body was separated from the sirup or sugar-like body. The crystal lized body was readily soluble in water. It was without effect upon the ray of polarized light, consequently it was not dextrose. It is reserved for further examination.

The sirup or sugar-like body was most soluble in water and reduced Fehling's solution powerfully, and had a levorotatory action upon the ray of polarized light, but to only a small specific degree. After standing some days in a desiccator a symptom of crude crystallization occurred in the form of warty aggregates, which, however, were still saturated with the sirup. When a few of the aggregates were separated from the sirup and their aqueous solution repolarized the levorotatory action had become almost totally neutralized, indicating that the sirup is composed of parts of dextrose and levulose, and in such proportions as mutually neutralize their opposite actions on the polarized ray. The water solution of those mixed sugars gave a phenyl-hydrazine compound with the characteristics of the dextrose compound. The further study and identification of those sugars which are the decomposition and hydration products of a portion of the original precipitate soluble in dilute H_2SO_4 are reserved.

(*b*) The part of the sirup which has been described as being coagulated by alcohol was soluble for the most part in water. To the aqueous solution was added 1.5 per cent. H_2SO_4 and the flask set aside for 4 days. During the 4 days that the solution was standing a crystallized body separated out in clusters of fine silky needles. The crystallized body was soluble in water, but not readily. With H_2SO_4 no reaction occurred. With $BaCl_2$ a heavy precipitate of $BaSO_4$ was given, indicating that the crystallized body was an organic sulphate compound.

After separation of the crystallized body spoken of, the solution was boiled for 4 hours, neutralized, and evaporated to a sirup. The sirup was taken up in water, treated with boneblack, and afterwards concentrated to a small volume and brought into a bottle with 5 volumes of alcohol and placed in the freezer. A large amount of amorphous body separated out which was soluble in water, gave no reaction with iodine, nor with phosphotungstic acid, but was precipitated with Pb acetate. The body is reserved for further examination. It thus appears that the portion of the original precipitate which was soluble in dilute H_2SO_4 is composed of bodies resembling the bodies which were found soluble in water, and differing from the latter in the manner or degree of their solubilities. A modification of, or a less soluble mucilage or gum has been observed, which by treatment with a dilute acid became broken up into copper reducing sugars and other undetermined matters. Another body gave a crystallized compound with H_2SO_4, and a third body was found which showed an indifference to iodine and phosphotungstic acid. The precise chemical study and classification of these bodies is reserved.

Bodies soluble in dilute sodic hydrate.—The residue of the original precipitate, after the treatments already described, was further submitted to the action of dilute sodic hydrate with a concentration of 1.5 per cent. The material was saturated with a large volume of NaOH for 4 days. After separation from the residue the solution was treated

first with phosphotungstic acid, when a heavy precipitate was thrown down in very singular forms, and most resembling ants' eggs. This body was insoluble in water and in strong NaOH. When no further precipitate was obtained with phosphotungstic acid, a little concentrated hydrochloric acid was added to the filtrate from which the phosphotungstic had been separated, and a second, but smaller precipitate was obtained which behaved like a true albuminoid. Those bodies have not yet been further examined.

4. *Bodies soluble in cuprammonium.*—After the treatment with NaOH a still considerable part of the original precipitate was remaining. Upon removing the alkali the material was saturated with a solution of cuprammonium for a period of 10 days, being frequently shaken and agitated during the whole time. The solution was filtered through glass wool, and concentrated HCl added, when a voluminous precipitate was given. Upon adding the HCl until the solution was slightly acid a large part of the precipitate became redissolved. The undissolved part of the precipitate thrown down with the HCl was separated by filtering and behaved completely as true cellulose. The other part resembling the true cellulose in so far that it was insoluble in the solvents used previous to cuprammonium, was distinguished from cellulose by its ready solubility in a slight excess of HCl. The filtrate in which the latter body was precipitated out of the solution with strong alcohol and also with NaOH and partly with phosphotungstic acid, indicating that it could be a mixture of mucilaginous and carbohydrate bodies or matters.

The last portion of the original precipitate which resisted the action of the solvents preceding the use of cuprammonium exhibited a similar mixture or combination of mucilaginous and carbohydrate bodies found in the portions soluble in water and H_2SO_4, and appearing to differ mainly in the degree of solubility. By the cuprammonium was discovered and obtained a preparation of true cellulose, which appears to have been in combination with the other body which was separated from the cellulose as already described. It is possible that the latter body may be a carbohydrate which is soluble in an excess of acid which would not affect the cellulose. However, the combination of the cellulose with a gum or mucilage body is strongly indicated.

In recapitulating the results of this preliminary study of the amorphous matters contained in the sorghum molasses, and which prevent the separation of the crystallizable bodies, it has been found that those amorphous matters are composed of nitrogenous mucilaginous and carbohydrate bodies. It has further been observed that each class of those bodies is represented by several modifications which are distinguished mainly by their differing degrees of solubilities: that is, that there are mucilaginous and carbohydrate bodies which are distinguished from each other by the instance that certain are soluble in water, others in

dilute acids, dilute alkalis, and cuprammonium respectively, which confirms the physiological supposition upon which the preliminary study of those amorphous matters was based and commenced, viz, that the whole of such were not probably to be found soluble in water.

Not only have mucilages and carbohydrates been observed during the course of these studies in the sorghum molasses; certain nitrogenous bodies have been found. A general view of the organic series of bodies (other than sugars) in the molasses may be gained by means of consecutive fractional precipitations with the following reagents: By addition of Pb acetate to an aqueous solution of the molasses, the chief part of the mucilaginous and certain carbohydrate matters with organic acids, etc., are thrown out. Upon removing the excess of lead from the filtrate other amorphous carbohydrates are removable with strong alcohol. And, finally, after removing by evaporation the alcohol from the filtrate and taking up the residue in water and purifying with bone black, by adding phosphotungstic acid an alkaloidal principle may be found. Such a body has been obtained by a different method and in a crystallized form as a double salt of chloride of platinum, of which a specific study has not yet been made.

The investigations will be continued in order to identify definitely certain of the mucilaginous and carbohydrate bodies of which only preliminary observations have been obtained. By such means it may be possible to further unfold the relations of those bodies represented and accompanying each other in the several modifications and degrees of solubility which have been observed, and also to work out a path to the better understanding of such as the pectinous bodies which have been thought to be mucilaginous and carbohydrate compounds.

The principle upon which the investigations have been conducted has so far been physiological-chemical, and especially having in view the nature of the total and respective bodies found in the molasses as indicated by their order of solubilities.

Having established methods by which the total original precipitate can be separated into several classes of bodies, each class of bodies and body is to be studied separately, in order to ascertain their chemical nature as indicated by the decomposition products and other chemical behavior.

CHEMICAL CONTROL OF SORGHUM SUGAR FACTORIES.

The Department made no direct experiments during the season of 1890 in the manufacture of sorghum sugar. The work done was confined solely to chemical supervision of the processes of manufacture. To secure as wide an experience as possible in this direction, chemists were detailed from the Department for the factories at Fort Scott, Topeka, Conway Springs, Attica, and Medicine Lodge, Kansas. A sum-

mary of the chemical work done, together with such data as were accessible, will be found following:

OPERATIONS AT ATTICA, KANSAS.

The chemical work at Attica was in charge of Mr. J. L. Fuelling, assisted by Mr. J. R. Cooper.

Work at this station was started on the 19th of September and continued, at intervals, until October 25. On this latter date one of the lower doors of the diffusion battery cell was broken and it was not thought worth while to repair the battery for the remaining portion of the crop. A very small quantity of cane remained unworked. The many difficulties encountered in the working of this house would render it unjust to make the results a test of the possibilities of manufacture of sorghum sugar.

The cane crop was much shortened by a severe drought, which set in about a month after the planting and continued unbroken for 60 days. The yield of cane per acre was reduced from 12 to 15 tons of last year to 5 and even 3 tons per acre. Chinch-bugs were also quite numerous and did considerable damage. Hot winds, the most dreaded enemy of the farmer in that region, were prevalent during the continuation of the drought. Not only was the crop shortened by the continued dry weather, but also the supply of water for the factory was inadequate, the small stream upon which dependence was placed having been completely dried up. Under these conditions the factory was not operated continuously, but only during the day.

The necessity of better cultivation of the cane fields was fully manifested in a number of instances. The fields which received poor cultivation were almost devoid of crops, while those which received the best cultivation yielded a fair crop in spite of the hot and dry weather. It was not until October 12 that there were sufficient rains to insure an ample supply of water, but at that time it was not possible to get enough cane to operate the factory.

The seed which had been received from the Department of Agriculture produced, in all cases, the best cane grown in the locality, averaging 4 and 5 tons per acre above all other varieties. The loss of a large quantity of sugar in the battery was owing to the heaters which leaked very badly. Another serious loss occurred between the clarifiers and double effects. This was due to the inability of the double effects to evaporate the juice extracted so that some of the thin juice was left sometimes as long as 12 hours before being concentrated, and, of course, fermentation took place.

Special attention was given to studying the characteristics of the cane, showing that certain physical properties are associated with high percentages of sugar. By studying these properties carefully, it is possible for every farmer to go into his field and be able to determine certainly whether his cane is ripe or not. The most striking of those prop-

erties is found in the last joint of the cane bearing the seed head. By stripping the cane of its covering a yellow coloration will be observed extending more or less along the length of the joint as the cane nears maturity. By the extent of this coloration one is able to select the very best or the very poorest canes in the field almost as accurately as though tested by a polariscope. It is found that the cane which has the highest sucrose, lowest glucose, and highest purity has this coloration extending one-half the length of the joint. Should it be found to extend the full length, it shows that the cane has already commenced to deteriorate. On the other hand, should no coloration be visible, it shows that the cane is not yet mature. These observations have extended over one season of rather remarkable characteristics, and hence they may not prove equally applicable to a crop grown in a season with the ordinary amount of rainfall.

The analyses of the sorghum at Attica were commenced on the 9th of September and continued until the 24th of October. During this period 115 average samples, as taken from the field, were analyzed with the following mean results:

In the juice.

Per cent. sucrose	14.26
Per cent. reducing sugars or glucose	1.53
Purity coefficient	71.91
Maximum per cent. sucrose	17.95
Minimum per cent. sucrose	5.85
Maximum per cent. reducing sugars or glucose	3.43
Minimum per cent. reducing sugars or glucose	.55
Maximum purity of juice	90.80
Minimum purity of juice	35.83

Between the dates of October 6 and 9 the purities of the juices were remarkably high, averaging about 85, and the percentages of sucrose therein were almost 16, showing that at that season the cane was in the best condition for manufacture. The analyses, however, for the whole season show a cane well suited for the manufacture of sugar, and which should yield, if all the sugar could be obtained, except the quantity which would naturally stay in the molasses, quite 200 pounds to the ton of clean cane.

Many of the farmers found the growing of cane profitable, while in other cases quite a number failed to make any profit or cultivated the cane at a loss. The figures representing one farmer's account with the company will illustrate what may be secured in a poor season in the growing of sorghum cane.

Total weight of cane grown	pounds	357,735
Total weight of seed grown	do	74,915
Amount received for the cane		$357.74
Amount received for the seed		$35.18
Total receipts for the crop		$392.92

Against this sum the following expenses are to be charged:

Cost of planting	$37.50
Cost of cultivating	50.00
Cost of harvesting and delivering to mill	175.00
Total cost, as charged	262.50

Leaving a net profit of $130.42. The number of acres cultivated in this crop was 30, and on the number given above the profit per acre would be $4.35. It will be noticed in the above that no charge has been made for the rent of the land, which is, of course, a legitimate expense which must come out of the calculated profit per acre. The rental of the land upon which this cane was grown is not known to me, but, judging from the average value of land in that locality, it may safely be put at $2 to $2.50; hence a deduction of $2 per acre should be made for rent of land, leaving a profit per acre of only $2.35 instead of $4.35.

The analyses of the samples of chips taken from the shredders as they pass to enter the battery, which samples give a fair estimate of the quality of the chips entering the diffusers, show, as is usual in all cases, a less saccharine strength than average samples of field cane. The reason of this difference is twofold. In the first place the samples of the first chips must of necessity give a better representation of the crop than any possible selection of single stalks or number of stalks of cane can give. In the second place, in spite of the best clarifying apparatus, particles of the blades and sheaths enter the shredder with the pieces of cane, and the juices of these are expressed afterward and mingle with the juices of the cane. Forty samples of these chips were analyzed during the season with the following mean reults:

In the juice.

Sucrose	per cent	12.56
Glucose	do	1.99
Purity		63.20

Thirty-two samples of the diffusion juices, representing the mean composition of the juices during the season, were subjected to analysis with the following mean results:

Sucrose	per cent	7.99
Glucose	do	1.20
Purity		66.48

Thirty-two samples of the exhausted chips, representing the mean composition of the whole mass of exhausted chips during the season, were analyzed, the analyses showing that they contained 0.60 per cent. of sucrose.

Twenty analyses of the filtered and clarified juices, representing the mean composition of the clarified juices of the whole season, showed the following average constitution:

Sucrose	per cent	8.11
Glucose	do	1.01
Purity		67.46

Seventeen analyses of the sirups before entering the strike pan, representing the average composition of the whole sirup worked during the season, gave the following mean results:

Sucrose	per cent..	32.91
Glucose	do....	7.12
Purity		63.11

Eight analyses of the massecuites, representing the average composition of the whole mass produced during the season, gave the following mean results:

Sucrose	per cent..	54.89
Glucose	do....	12.32
Purity		62.35

Five analyses of the second masse cuites, boiled from the first molasses after the separation of the first mass of crystals, showed the follow-lowing mean composition:

Sucrose	per cent..	47.52
Glucose	do....	12.77
Purity		55.65

The total amount of field cane purchased during the season was 1,305.3 tons. After cleaning, the total weight of cane which entered the diffusion battery was 900.2 tons.

The theoretical percentage of sugar in the clean cane, as calculated from the juice of the chips, was 238.6 pounds.

The quantity of sugar obtained in a merchantable form can not be accurately known until the official report of the State sugar C. innspector is known. The quantity, however, in proportion to the total amount present was extremely small and probably did not exceed 75 or 80 pounds per ton.

The enormous losses, therefore, in manufacturing sorghum sugar, which have always been noticed in practice, are illustrated in a very emphatic manner by the results of the season's work at Attica. Such losses are due to the natural wastage during the process of manufacture, and are, of course, raised to an unusual degree where lack of skill exists in the manipulation of the factory. The chief losses, however, as heretofore, have been due to the character of the juice itself, presenting in its constitution peculiar difficulties in the separation of the crystallizable sugar present.

Following are the summaries of the analyical data obtained:

Analyses of sorghum cane, Attica, Kansas, 1890.—Samples represent field averages.

No.	Date.	Sucrose.	Glucose.	Purity.	Variety of cane.	No.	Date.	Sucrose.	Glucose.	Purity.	Variety of cane.
1	Sept. 9	16.70	.....	75.09	Amber.	54	Oct. 6	14.50	2.52	86.10	Orange.
2	Sept. 9	15.70	.....	77.70	Do.	55	Oct. 6	16.25	1.32	89.59	Do.
3	Sept. 9	16.40	.....	78.60	Do.	56	Oct. 6	17.20	1.09	88.78	Do.
4	Sept. 9	15.75	.....	78.04	Do.	57	Oct. 6	15.65	1.69	86.41	Do.
5	Sept. 9	16.10	.....	76.37	Do.	58	Oct. 6	15.70	1.46	80.70	Do.
6	Sept. 9	14.35	.....	74.42	Do.	59	Oct. 6	17.95	.....	90.80	Do.
7	Sept. 9	14.35	.....	78.30	Do.	60	Oct. 8	15.10	2.66	81.44	Do.
8	Sept. 9	15.50	.....	78.50	Do.	61	Oct. 8	16.70	2.58	82.22	Do.
9	Sept. 9	12.50	.....	68.14	Do.	62	Oct. 8	14.00	1.32	70.31	Do.
10	Sept. 9	16.10	....	78.30	Do.	83	Oct. 8	12.65	1.77	70.35	Do.
11	Sept. 9	12.25	.....	73.48	Do.	84	Oct. 8	14.40	1.13	71.35	Do.
12	Sept. 10	16.10	.....	78.30	Do.	85	Oct. 8	13.60	1.22	74.71	Do.
13	Sept. 10	13.65	.. ..	75.70	Do.	86	Oct. 8	15.72	1.09	76.52	Do.
14	Sept. 10	15.10	.....	77.80	Do.	87	Oct. 8	14.00	1.25	74.35	Do.
15	Sept. 10	15.55	.....	75.81	Do.	88	Oct. 8	14.15	1.13	72.97	Do.
16	Sept. 10	14.60	.....	75.00	Do.	89	Oct. 8	14.85	1.74	71.79	Liberian.
17	Sept. 10	14.10	.....	73.86	Do.	90	Oct. 8	13.80	1.59	75.40	Do.
18	Sept. 10	15.05	.....	75.51	Do.	91	Oct. 8	13.05	1.44	79.63	Orange.
19	Sept. 10	15.55	.....	77.77	Do.	92	Oct. 8	13.15	1.17	71.15	Do.
20	Sept. 10	14.32	.....	75.42	Do.	93	Oct. 18	14.00	1.17	73.90	Do.
21	Sept. 10	15.82	.....	75.51	Do.	95	Oct. 18	14.50	1.19	74.82	Do.
22	Sept. 10	16.15	.....	77.23	Do.	96	Oct. 18	15.10	1.08	76.00	Do.
23	Sept. 10	11.90	.....	68.15	Do.	97	Oct. 18	13.30	1.45	79.62	Do.
24	Sept. 20	12.25	.....	68.82	Do.	98	Oct. 18	10.55	1.78	66.41	Do.
25	Sept. 20	13.15	.....	71.22	Do.	99	Oct. 18	11.65	1.98	70.00	Do.
26	Sept. 20	14.95	.....	80.94	Do.	100	Oct. 18	15.60	.59	69.79	Do.
31	Sept. 29	13.45	.....	70.90	Do.	101	Oct. 18	10.30	1.63	64.84	Do.
32	Sept. 29	15.15	1.18	73.18	Do.	102	Oct. 18	13.90	.76	74.77	Do.
33	Sept. 29	14.05	1.51	72.05	Do.	103	Oct. 18	8.60	1.28	46.82	Link's Hybrid.
34	Sept. 29	13.30	1.51	72.79	Do.						
35	Sept. 29	11.95	3.43	66.44	Do.	104	Oct. 18	15.10	1.42	78.52	Orange.
36	Sept. 29	12.95	1.77	71.72	Do.	105	Oct. 18	14.40	1.44	79.42	Do.
37	Sept. 29	12.60	1.56	76.23	Do	106	Oct. 18	10.00	1.88	66.53	Do.
38	Sept. 29	15.25	1.39	76.47	Do.	107	Oct. 18	13.65	1.33	75.45	Do.
39	Sept. 29	13.00	1.89	71.23	Do.	108	Oct. 18	14.65	1.48	75.24	Do.
40	Sept. 29	16.30	1.10	75.53	Do.	109	Oct. 23	10.55	1.40	67.87	Do.
41	Sept. 29	14.30	1.87	81.27	Do.	110	Oct. 23	14.70	1.46	73.63	Do.
42	Sept. 29	14.65	.95	73.84	Do:	111	Oct. 23	12.60	1.27	69.72	Do.
43	Sept. 29	14.50	1.17	72.86	Do.	112	Oct. 23	11.30	2.13	67.62	Do.
44	Sept. 29	15.25	1.24	73.13	Do.	113	Oct. 23	16.75	1.25	76.46	Do.
45	Sept. 29	13.05	1.25	70.01	Do.	114	Oct. 23	5.85	1.35	35.83	Do.
46	Sept. 29	17.10	1.04	77.34	Do.	115	Oct. 23	12.10	1.73	62.24	Do.
48	Sept. 29	13.15	1.16	74.00	Do.						
50	Sept. 29	13.25	1.79	75.85	Orange.		Averages .	14.26	1.53	71.91	
51	Sept. 29	13.65	1.73	73.64	Do.		Maxima ...	17.95	3.43	90.80	
52	Oct. 6	16.30	.55	76.06	Do.		Minima ...	5.85	.55	35.83	
53	Oct. 6	13.60	2.40	69.49	Do.						

From average sample of chips entering diffusion battery.—Fresh chip juice.

No.	Date.	Sucrose.	Glucose.	Purity.	No.	Date.	Sucrose.	Glucose.	Purity.
4	Sept. 19	12.20	.....	59.00	102	Oct. 17	13.60	1.77	70.87
6	Sept. 21	13.22	.....	67.27	108	Oct. 18	13.35	1.93	68.84
13	Sept. 26	11.85	4.25	58.6*	114	Oct. 18	12.55	1.46	68.24
16	Sept. 28	12.63	1.64	61.30	122	Oct. 19	13.60	1.50	71.28
20	Sept. 29	11.85	3.54	66.07	125	Oct. 19	13.15	1.70	69.90
28	Oct. 1	13.05	1.93	66.56	135	Oct. 20	12.85	1.80	67.70
34	Oct. 2	13.52	2.46	69.16	138	Oct. 20	9.20	1.67	50.63
35	Oct. 3	11.38	.88	59.02	145	Oct. 21	12.85	1.35	71.00
44	Oct. 6	12.32	2.17	61.58	152	Oct. 21	12.70	1.41	68.53
47	Oct. 6	12.32	2.71	63.81	157	Oct. 22	12.50	1.45	69.41
53	Oct. 7	13.00	3.79	59.38	166	Oct. 22	12.15	1.43	68.00
54	Oct. 7	13.00	3.49	59.38	168	Oct. 23	12.75	1.39	67.92
57	Oct. 7	9.46	2.16	46.61	174	Oct. 23	12.60	1.49	68.00
63	Oct. 8	15.08	3.39	76.98	178	Oct. 24	13.45	1.65	71.12
67	Oct. 14	14.76	1.65	73.85	184	Oct. 24	10.85	2.03	61.41
75	Oct. 15	12.70	1.50	70.05	190	Oct. 25	12.24	2.12	62.00
80	Oct. 15	13.00	1.42	71.86	192	Oct. 25	11.49	1.85	59.66
86	Oct. 16	12.60	1.64	70.66	199	Oct. 25	11.12	1.96	57.05
89	Oct. 16	13.40	1.63	73.29					
97	Oct. 17	12.95	1.52	70.13		Means. ...	12.56	1.99	63.20
101	Oct. 17	12.50	1.87	68.11					

Average samples of diffusion juice.

No.	Date.	Sucrose.	Glucose.	Purity.	No.	Date.	Sucrose.	Glucose.	Purity.
11	Sept. 20	8.65	3.79	76.56	104	Oct. 17	7.47	.72	71.17
15	Sept. 28	8.68	2.95	70.62	115	Oct. 18	9.29	.85	71.50
21	Sept. 29	7.20	2.03	63.10	120	Oct. 18	6.90	.69	72.03
21*a*	Sept. 29	8.89	.....	69.15	123	Oct. 19	8.11	1.69	72.34
29	Oct. 1	7.90	.80	69.23	127	Oct. 19	8.95	1.00	70.53
30	Oct. 1	7.90	.87	70.47	140	Oct. 20	6.23	.64	68.22
50	Oct. 6	8.40	1.65	68.62	148	Oct. 21	6.89	.67	62.18
58	Oct. 7	8.92	1.90	62.07	149	Oct. 21	8.58	.66	80.79
59	Oct. 7	8.55	1.73	62.10	161	Oct. 22	7.32	.71	70.00
65	Oct. 8	10.33	1.43	81.06	162	Oct. 22	9.08	.65	75.22
68	Oct. 14	8.83	1.66	59.84	171	Oct. 23	8.61	.96	69.18
77	Oct. 15	9.17	.90	72.00	180	Oct. 24	7.90	.92	71.23
81	Oct. 15	9.14	.66	71.91	183	Oct. 24	7.54	1.09	61.05
91	Oct. 16	8.48	.75	72.82	193	Oct. 25	7.93	.78	65.26
92	Oct. 16	9.07	.83	71.94					
103	Oct. 17	9.08	.95	68.78		Means	7.99	1.20	66.48

Average samples of filtered and clarified juice.

No.	Date.	Sucrose.	Glucose.	Purity.	No.	Date.	Sucrose.	Glucose.	Purity.
18	Sept. 28	7.63	1.07	65.58	105	Oct. 17	7.78	.77	73.28
22	Sept. 29	9.30	1.24	67.68	116	Oct. 18	8.48	.87	74.54
22	Sept. 29	7.60	.95	65.34	129	Oct. 19	8.21	1.00	68.00
30	Oct. 1	7.90	.87	70.47	143	Oct. 20	6.62	.53	70.53
38	Oct. 3	8.57	1.12	68.32	151	Oct. 21	7.85	.67	69.00
51	Oct. 6	6.05	1.18	57.50	164	Oct. 22	7.94	.63	71.34
60	Oct. 7	7.80	1.74	56.23	176	Oct. 23	7.95	.91	67.74
61	Oct. 7	9.10	1.75	63.46	185	Oct. 24	7.68	.90	64.97
69	Oct. 14	9.29	1.58	69.10	196	Oct. 25	8.19	.99	66.15
79	Oct. 15	8.90	.71	68.04					
95	Oct. 16	8.42	.78	72.05		Means.....	8.11	1.01	67.46

Average samples of sirups.

No.	Date.	Direct sucrose.	Indirect sucrose.	Glucose.	Purity.
12	Sept. 22	32.80	.....	10.63	58.01
14	Sept. 26	32.80	.....	.....	58.84
24	Sept. 29	32.60	32.64	9.50	60.26
25	Sept. 30	37.80	.....	9.36	64.59
26	Oct. 1	35.80	36.06	8.35	64.04
40	Oct. 4	29.40	.....	.....	63.18
62	Oct. 7	32.40	32.42	6.81	57.29
74	Oct. 15	31.75	31.94	9.96	58.16
87	Oct. 16	39.20	38.10	6.30	66.91
107	Oct. 18	37.10	35.54	5.51	68.33
121	Oct. 19	37.70	36.99	5.65	67.87
134	Oct. 20	34.00	33.43	5.75	57.94
147	Oct. 21	26.50	25.94	5.72	65.11
158	Oct. 22	32.40	31.48	5.88	73.50
177	Oct. 23	25.80	27.46	5.37	62.88
189	Oct. 25	31.00	30.29	5.85	65.34
201	Oct. 26	30.50	29.73	6.13	60.56
	Means	32.91	32.46	7.12	63.11

Average samples of first masse cuite.

No.	Date.	Brix.	Direct sucrose.	Indirect sucrose.	Glucose.	Purity.
27	Oct. 1	88.30	52.80	54.58	16.22	59.80
45	Oct. 6	89.01	58.00	56.90	11.70	65.16
76	Oct. 15	82.90	46.00	48.42	12.33	55.48
111	Oct. 18	87.60	51.50	.....	11.34	58.79
156	Oct. 21	89.00	62.00	61.66	13.25	69.62
202	Oct. 27	93.26	59.20	60.32	12.89	65.56
203	Oct. 27	92.41	59.20	60.34	9.27	64.06
205	Oct. 27	81.72	50.40	50.60	11.57	61.67
	Means...	88.03	54.89	56.12	12.32	62.35

SECOND MASSE CUITE.

204	Oct. 28	87.60	46.80	49.18	14.39	53.42
206	Oct. 28	79.68	47.80	49.22	13.01	59.98
207	Oct. 29	81.72	46.40	47.92	11.57	56.77
214	Nov. 3	89.45	48.00	49.49	12.92	53.66
215	Nov. 3	87.60	48.60	49.62	11.96	55.48
	Means...	85.21	47.52	49.08	12.77	55.65

Average samples of exhausted chip juice.

No.	Date.	Sucrose.	Purity.	No.	Date.	Sucrose.	Purity.
5	Sept. 19	2.17	40.42	98	Oct. 17	.62	32.28
7	Sept. 20	1.39	47.76	109	Oct. 18	.46	25.27
10	Sept. 20	.36	23.68	112	Oct. 18	.77	31.95
23	Sept. 29	.41	26.28	124	Oct. 19	.51	25 37
31	Oct. 1	.67	37.84	136	Oct. 20	1.13	45.01
33	Oct. 2	.83	43.20	142	Oct. 20	.93	41.70
36	Oct. 3	.31	18.56	144	Oct. 21	.53	51.88
46	Oct. 6	.26	15.11	154	Oct. 21	.77	47.85
48	Oct. 6	.36	22.35	159	Oct. 22	.31	25.62
55	Oct. 7	.62	30.00	160	Oct. 22	.31	25.62
64	Oct. 8	1.55	61.27	169	Oct. 23	.41	28.09
66	Oct. 14	.50	27.83	170	Oct. 23	.76	36.01
73	Oct. 15	.50	35.46	181	Oct. 24	.56	33.53
78	Oct. 15	.35	24.00	191	Oct. 25	.41	31.29
85	Oct. 16	.75	31.51	198	Oct. 25	.41	27.15
88	Oct. 16	.57	30.00				
90	Oct. 16	.62	35.23		Means.....	.60	32.63

Summary of results of chemical contral at Attica, Kansas, 1890.

Cane purchased	tons..	1,305.30
Do	pounds..	2,610,723.00
Cane spoilt on carrier due to "shut down"	do....	40,087.00
Do	tons..	20.04
Clean cane	tons..	900.20
Do	pounds..	1,800,529.00
Loss in weight due to cleaning	tons..	405.10
Do	pounds..	770,107.00
Do	per cent..	30.73
Amount of—		
Clean cane diffused	tons..	900.20
Do	pounds..	1,800,529.00
Juice in clean cane	do....	1,620,476.10
Do	gallons..	179,542.80
Sucrose in clean cane, juice	pounds..	214,835.00

Amount of—		
Glucose in clean cane, juice	do	34,038.00
Sucrose per ton of clean cane	pounds	238.60
Glucose per ton of clean cane	do	37.89
Sucrose per ton of field cane	do	164.60
Glucose per ton of field cane	do	26.50
Sucrose in exhausted chips—		
Regular draw	do	8,344.00
Last 8 cells	do	4,056.00
Total	do	12,400.00
Regular draw	per cent	0.60
Last 8 cells	do	0.99
Per cent extraction	do	95.33
Loss of sucrose, due to leaky heaters	pounds	45,438.50
Amount of—		
Skimmings returned to battery	gallons	7,877.00
Do	pounds	66,965.00
Sucrose in skimmings	do	2,551.00
Glucose in skimmings	do	448.00
Diffusion juice, regular draw	gallons	148,850.00
Do	pounds	1,283,812.00
Diffusion juice last 8 cells	gallons	96,084.00
Do	pounds	822,097.00
Sucrose in diffusion juice, regular draw	do	102,576.50
Glucose in diffusion juice, regular draw	do	15,405.00
Sucrose in diffusion juice, last 8 cells	do	56,971.00
Glucose in diffusion juice, last 8 cells	do	6,740.00
Total weight of sucrose in diffusion juice	do	169,547.50
Total weight of glucose in diffusion juice	do	22,146.00
Actual weight of sucrose—sucrose of diffusion juice—sucrose in skimmings	pounds	156,996.50
Actual weight of glucose—glucose of diffusion juice—glucose in skimmings	pounds	21,698.00
Total weight of clarified juice	do	1,283,812.00
Total loss of sucrose juice due to manipulation and inversion		None.
Total loss of sucrose as skimming		Not estimated.
Total loss of sucrose in juice, before and after leaving triple effect, pounds		7,752.60
Total amount of—		
Sugar obtained as firsts	do	36,050.00
Sugar, per ton of field cane	do	28.90
Sugar, per ton of clean cane	do	40.04
Second masse cuite	gallons	8,237.28
Do	pounds	101,708.00
Sucrose in second masse cuite	do	49,928.70
Glucose in second masse cuite	do	12,988.00
Remaining unboiled "first molasses"	do	32,552.60
Sucrose in unboiled "first molasses"	do	11,484.50
Glucose in unboiled "first molasses"	do	4,203.70
On hand	do	97,463.20
Sucrose burned, due to poor boiling	do	15,731.30

OPERATIONS AT FORT SCOTT, KANSAS.

The chemical work at Fort Scott was conducted by Mr. E. E. Ewell.

In all, 1,115 acres of cane were contracted for by the company; 7,575 tons were received, the weight being taken after the removal of the seed heads. This showed an average yield of 6.875 tons per acre. One-third of the total amount was Early Amber cane, and the remainder, with the exception of 100 acres of Link's Hybrid, was Orange cane.

The season was dry in the early part, but the latter part of it was wet. The wet weather coming late in the season was of great benefit to the late canes, but caused a second growth of the more mature.

The total amount of sugar made was 356,365 pounds, and the amount of molasses approximately 95,000 gallons. The average yield of sugar per ton was 48.5 pounds, after deducting 230 tons of cane which were worked for molasses alone. The average yield of molasses per ton was 14.5 gallons.

One thousand seven hundred and twenty tons of coal were consumed during the entire season.

The work during the season was retarded by many accidents to the machinery; the largest number of diffusion cells worked in 24 hours being 134. Had this rate of work continued, only 52 days would have been consumed in the campaign instead of 74.

The chief causes of delay were a lack of capacity in the multiple-effect evaporator and an insufficient supply of cane. Most of the delays experienced could have been avoided by a thorough overhauling of the machinery during the 9 months it was lying idle.

By allowing the clarified juice to stand in settling tanks a large amount of sediment was removed, and this was returned to the battery.

The analytical data obtained will be found in detail in the following tables:

Analyses of average samples of sirups, massecuites, and sugars.

Date boiled.	Strike No.	Sirups. Solids.	Sirups. Sucrose.	Sirups. Glucose.	Sirups. Purity	Massecuites. Solids.	Massecuites. Sucrose.	Massecuites. Glucose.	Massecuites. Purity	Sugars. Date.	Sugars. Sucrose.	Strike.
1890.		*Pr. ct.*	*Pr. ct.*	*Pr. ct.*		*Pr. ct.*	*Pr. ct.*	*Pr. ct.*			*Pr. ct.*	
Sept. 10	13	51.18	31.20	.....	60.80	90.10	57.80	.....	64.20	Sept. 18	96.00	....
Sept. 11	14	46.00	.....	.....	....	90.75	57.40	14.45	63.30	Sept. 20	94.60	....
Sept. 14	15	57.18	32.04	.....	56.30	88.76	50.20	.....	56.60	Sept. 24	91.90	....
Sept. 15	16	52.70	32.10	.....	60.90	89.49	56.60	.....	63.20	.....	.....	...
Sept. 16	17	50.42	28.90	10.00	57.70	90.04	51.70	.....	57.40	Sept. 25	95.40	...
Sept. 17	18	50.20	31.20	8.16	62.10	91.38	56.80	.....	62.20	Sept. 26	92.70	....
Sept. 18	19	52.00	31.50	9.30	60.60	89.53	54.20	.....	60.54	Sept. 28	93.40	...
Sept. 19	20	51.32	30.10	10.26	58.70	90.70	53.20	.....	58.65	Sept. 29	93.90	...
Sept. 20	21	51.60	29.60	10.70	57.90	90.39	53.20	18.84	58.85	Sept. 29	92.20	....
Sept. 21	22	49.50	29.25	9.39	59.10	90.49	54.24	18.10	59.94	Sept. 30	93.10	....
Sept. 22	23	50.52	30.20	8.96	59.80	90.48	54.46	17.47	60.19	Oct. 1	92.30	...
Sept. 23	24	51.24	.....	9.38	.....	90.17	54.28	17.66	60.19	Oct. 2	91.40	...
Sept. 24	25	48.93	30.04	7.84	61.40	89.55	55.96	14.88	62.49	Oct. 4	91.00	....
Sept. 25	26	51.44	32.48	7.60	63.10	.....	56.78	.....	.....	Oct. 5	91.50	....
Sept. 26	27	48.76	30.49	6.87	62.30	89.58	57.72	13.50	64.43	Oct. 6	92.90	....
Sept. 28	28	53.51	32.39	7.90	60.50	89.95	55.88	12.50	62.12	Oct. 7	84.40	....
Sept. 30	29	54.49	35.17	7.72	64.50	90.72	57.76	14.00	63.66	Oct. 8	91.40	....
Oct. 1	30	47.23	30.15	6.85	63.80	.....	57.12	13.50	.....	Oct. 10	97.20	....
Oct. 2	31	49.35	30.79	7.91	62.40	90.95	56.08	15.03	61.66	Oct. 11	94.10	....
Oct. 3	32	44.18	28.19	6.83	63.80	89.76	55.52	13.69	61.85	Oct. 12	94.10	....
Oct. 4	33	43.50	27.44	7.23	63.10	90.20	56.75	14.25	62.90	Oct. 12	95.70	....
Oct. 5	34	46.07	28.71	7.86	62.30	90.10	56.06	14.76	62.20	Oct. 13	96.10	...
Oct. 6	35					89.56	54.82	14.66	61.20	Oct. 14	95.00	...
Oct. 8	36	54.96	34.35	9.13	62.50	89.39	54.94	15.03	61.50	Oct. 14	94.90	...
Oct. 9	37					88.93	55.30	15.88	62.20	Oct. 15	94.80	..
Oct. 10	38	57.62	34.80	11.58	60.40	88.80	53.10	17.66	59.80	Oct. 16	94.20	....
Oct. 11	39					90.20	53.76	17.66	59.60	Oct. 17	92.30	....
Oct. 12	40	54.50	32.17	11.25	59.50	88.20	52.58	.....	59.60	Oct. 17	93.70	....
Oct. 13	41					88.60	51.52	.....	58.20	Oct. 18	93.90	....
Oct. 14	42	52.00	32.05	9.25	61.60	87.90	52.96	.....	60.30	Oct. 19	93.20	....
Oct. 15	43					88.70	55.24	.....	62.30	Oct. 20	94.80	...
Oct. 16	44	54.84	35.55	8.75	64.80	88.70	56.10	.....	63.20	Oct. 22	92.70	....
Oct. 17	45	51.12	32.36	7.91	63.30	87.70	54.68	.....	62.30	Oct. 23	95.20	....
Oct. 18	46					88.60	55.62	.....	62.80	Oct. 24	96.10	....
Oct. 19	47	46.47	27.94	8.36	60.10	89.40	53.28	.....	59.60	Oct. 24	95.80	....
Oct. 20	48					88.80	53.96	.....	60.80	Sept. 10	92.30	9
Oct. 21	49	49.07	31.39	7.89	63.90	89.40	55.36	.....	61.90	Sept. 12	93.70	10
Oct. 22	50					93.00	57.14	.....	61.40	Sept. 15	92.50	11
Oct. 23	51	48.80	32.41	.....	66.40	.....	.....	.....	.....	Sept. 19	94.10	12
Oct. 24	52											
Minima		43.50	27.44	6.87	56.30	87.70	50.20	12.50	56.60	.....	84.40	....
Maxima		57.62	35.55	11.58	66.40	93.00	57.80	18.84	64.43	.....	97.20	....
Means		50.67	31.21	8.65	61.59	89.69	55.00	15.45	61.20	.....	93.50	....

Analyses of average samples of juice of exhausted chips.

Date.	Sucrose.	Sucrose, average for day.	Date.	Sucrose.	Sucrose, average for day.	Date.	Sucrose.	Sucrose, average for day.
1890.	*Per cent.*	*Per cent.*	1890.	*Per cent.*	*Per cent.*	1890.	*Per cent.*	*Per cent.*
Sept. 9	1.15	1.15	Sept. 21	.88	.....	Oct. 9	.....	.99
Sept. 10	.92	.....	Sept. 21	.88	.88	Oct. 10	.....	.76
Sept. 10	1.40	.....	Sept. 22	.72	.....	Oct. 11	1.44	.....
Sept. 10	.31	.88	Sept. 22	.66	.....	Oct. 11	.68	1.06
Sept. 11	.31	.....	Sept. 22	.66	.68	Oct 12	.51	.51
Sept. 11	.40	.....	Sept. 23	.46	.....	Oct. 13	.79	.79
Sept. 11	.46	.39	Sept. 23	.57	.52	Oct. 14	.82	.82
Sept. 12	.31	.31	Sept. 27	.41	.41	Oct. 15	1.27	1.27
Sept. 13	.41	.....	Sept. 28	.72	.72	Oct. 16	.65	.65
Sept. 13	.52	.....	Sept. 29	.68	.....	Oct. 17	1.18	1.18
Sept. 13	.67	.53	Sept. 29	.37	.53	Oct. 18	.63	.....
Sept. 14	.62	.62	Sept. 30	.40	.....	Oct. 18	.60	.62
Sept. 15	.57	.....	Sept. 30	.68	.54	Oct. 20	.65	.....
Sept. 15	1.20	.89	Oct. 1	.74	.....	Oct. 20	.88	.77
Sept. 16	1.00	.....	Oct. 1	.57	.66	Oct. 21	.....	1.10
Sept. 16	1.20	1.10	Oct. 2	.71	.....	Oct. 22	.93	.....
Sept. 17	1.19	.....	Oct. 2	.91	.....	Oct. 22	.79	.86
Sept. 17	.67	.93	Oct. 2	.46	.69	Oct. 23	.....	.99
Sept. 18	.41	.....	Oct. 3	.....	.79			
Sept. 18	.41	.41	Oct. 4	.....	.74	Minimum		.31
Sept. 19	.77	.77	Oct. 7	.....	.82	Maximum		1.27
Sept. 20	.77	.77	Oct. 8	.....	.71	Mean		.74

Analyses of average samples of clarified juice.

Date.	Solids.	Sucrose.	Glucose.	Purity.	Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	
Oct. 9	16.11	9.63	.....	59.80	Oct. 20†	17.28	11.60	.....	67.13
Oct. 12	15.30	9.05	.....	59.08	Oct. 21‡	15.30	9.96	1.82	65.14
Oct. 13	16.76	10.40	2.44	62.06	Oct. 22‡	15.33	10.12	1.66	66.18
Oct. 14*	13.46	9 19	.....	68.24	Oct. 23	15.89	10.56	.....	66.50
Oct. 15	14.86	9.49	1.81	63.80					
Oct. 16	15.27	9.42	1.83	61.60	Means ..	15.53	9.81	2.06	63.16
Oct. 17	16.09	10.07	2.16	62.58	Maxima.	17.28	11.60	2.45	68.24
Oct. 18	14.79	8.66	2.34	58.53	Minima .	13.46	8.66	1.66	58.53
Oct. 19	15.49	9.38	2.45	60.55					

*Sample not strictly comparable with sample of diffusion juice.

†6 barrels refuse sugar added.
‡1½ barrels refuse sugar added.

Analyses of average samples.

Normal acetate of lead was used as a preservative from September 9 to October 8, inclusive. Basic acetate of lead was used as a preservative from October 9 to October 23, inclusive.

Date.	Normal juice from chips entering battery.				Diffusion juice.				Actual dilution in battery.
	Solids.	Sucrose.	Glucose.	Purity.	Solids.	Sucrose.	Glucose.	Purity.	
1890.	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*		
Sept. 9	16.73	10.78	.....	64.3	12.47	8.42	.....	67.4	34.2
Sept. 10	15.21	9.05	.....	59.5	12.26	8.05	.....	65.3	24.1
Sept. 11	16.83	10.12	.....	50.02	11.37	7.43	.....	65.3	48.0
Sept. 11	16.73	9.70	.....	57.9	11.50	7.25	2.04	63.04	45.5
Sept. 12	16.94	8.63	3.28	50.9	12.05	7.15	2.16	59.3	27.9
Sept. 13	16.52	10.34	2.37	62.6	12.51	7.44	1.88	59.50	36.4
Sept. 15	16.11	9.52	2.79	59.1	11.65	7.37	1.98	63.3	31.7
Sept. 16	15.56	9.63	2.75	61.9	11.43	7.37	1.86	64.5	34.1
Sept. 17	16.63	9.35	3.74	56.2	12.38	7.37	2.37	59.5	34.4
Sept. 18	16.80	9.19	4.35	54.1	12.78	7.15	2.82	55.9	35.8
Sept. 19	17.08	9.90	3.17	57.9	13.09	7.81	2.65	59.6	24.9
Sept. 20	17.24	10.34	3.21	59.9	12.76	7.76	2.56	60.8	31.3
Sept. 21	16.14	9.63	3.25	59.6	12.95	8.18	2.58	63.16	19.7
Sept. 22	16.88	11.20	2.55	66.3	13.13	8.62	2.05	65.7	28.8
Sept. 23	17.10	10.98	2.76	64.2	13.53	8.74	2.16	64.6	26.1
Sept. 24	16.80	10.74	2.70	63.93	13.26	8.52	2.13	64.25	26.2
Sept. 25	16.30	10.29	2.65	63.13	13.77	8.69	2.42	63.11	16.4
Sept. 26‖									
Sept. 27‖	16.28	9.96	2.72	61.18	13.0	8.41	2.08	64.69	20.9
Sept. 28	16.85	10.45	2.32	62.18	13.27	8.31	2.07	62.62	23.0
Sept. 29	16.99	10.45	.....	61.51	13.08	8.36	2.00	63.91	29.9
Sept. 30	17.90	11.04	2.52	64.01	14.41	9.36	2.37	64.95	15.6
Oct. 1	16.62	10.56	2.85	63.54	13.52	8.60	2.16	63.61	24.6
Oct. 2	16.73	10.56	2.58	63.12	14.80	9.56	2.40	64.59	10.9
Oct. 3	16.75	10.51	2.58	62.75	13.74	8.63	2.20	62.81	20.9
Oct. 4	16.26	9.07	3.11	55.78	13.64	8.58	2.29	62.9	12.1
Oct. 7	16.93	10.96	.....	64.7	13.05	8.13	.....	62.3	29.7
Oct. 8	19.23	11.18	.....	58.09	15.73	9.45	.....	60.06	22.2
Oct. 9	18.93	11.66	.....	61.59	15.35	9.29	.....	60.52	25.5
Oct. 10	18.60	11.50	2.72	61.83	14.58	8.58	2.52	58.85	28.1
Oct. 11	.....	.....	.....	.....	15.17	8.69	2.82	57.28	.....
Oct. 12	18.89	11.51	.....	60.87	14.85	8.66	.....	58.31	27.8
Oct. 13	17.97	11.83	2.12	65.83	15.51	9.71	2.17	62.6	17.4
Oct. 14	18.96	12.59	1.93	66.43	13.72	8.75	1.63	63.74	39.9
Oct. 15	18.93	11.99	2.25	63.3	14.75	9.24	1 98	62.5	26.8
Oct. 16	18.55	12.21	2.24	65.8	14.99	9.35	2.00	62.3	27.3
Oct. 17	19.00	12.27	2.42	64.68	15.46	9.38	2.24	60.67	26.4
Oct. 18	18.91	10.73	3.62	56.74	15.09	8.53	2.66	56.53	28.2
Oct. 19	19.19	12.32	2.42	64.20	15.34	9.30	2.31	60.63	27.0
Oct. 20	18.30	12.60	1.93	68.85	14.71	9.43	1.88	64.11	28.5
Oct. 21	17.61	11.99	1.71	68.09	14.56	9.43	1.72	64.76	22.9
Oct. 22	17.57	12.21	1.66	69.49	14.67	9.63	1.72	65.65	22.2
Oct. 23	17.86	12.10	.....	67.64	15.28	10.07	.....	66.05	16.9
Minima*	15.21	8.63	1.66	50.02	11.37	7.15	1.63	55.9	10.9
Maxima*	19.23	12.60	4.35	69.49	15.51	10.07	2.82	67.4	48.0
Means*	17.33	10.77	2.69	62.15	13.69	8.54	2.20	62.38	26.8
Minima†	15.21	8.63	2.32	50.02	11.37	7.15	1.86	55.9	10.9
Maxima†	19.23	11.20	4.35	64.7	14.80	9.56	2.82	67.4	48.0
Means†	16.71	10.15	2.91	60.74	13.00	8.18	2.14	62.92	27.2
Minima‡	16.26	10.73	1.66	56.74	13.72	8.53	1.63	56 53	12.1
Maxima‡	19.19	12.60	3.62	69.49	15.51	10.07	2.82	66.05	39.9
Means‡	18.52	11.97	2.27	64.63	14.94	9.20	2.24	61.58	26.1

*For the season.
†From September 9 to October 8, inclusive.
‡From October 9 to October 23, inclusive.

OPERATIONS OF THE TOPEKA FACTORY.

The chemical work at Topeka was in charge of Mr. Oma Carr, assisted by Mr. Lewis H. Bradford.

The Topeka Sugar Factory, which was destroyed by fire last year, was rebuilt during the present season and operated for the manufacture of sugar.

Difficulties of various kinds, but in no wise inherent to the process of manufacture, caused delays in the operations of the factory, and rendered its work expensive. The supply of steam was not sufficient for the full working extent of the rest of the machinery, and the multiple effect pans were provided with very low domes, which rendered successful boiling difficult. Moreover, the fuel employed was of particularly bad quality. The pumping arrangements were found inadequate to provide an abundant supply of water.

The crop of cane was somewhat later in maturing than usual, due to the autumnal rains following a very dry summer. The crop ripened in a very irregular way, thus causing to be delivered to the factory canes in various stages of maturity. The amber cane reached its maximum maturity about the middle of September, and the orange cane about the middle of October.

The battery work was extremely irregular, the percentages of dilution ranging from 8 to 14, and the percentages of extraction of sugar from 80 to 95 per cent. The percentages of sucrose in the exhausted chips vary from 0.5 per cent to 2 per cent; the number of diffusion cells worked daily varied from twenty-three to one hundred and four, and the loss of time daily by stoppages was from 2 to 14 hours. Under such irregular conditions of work, due generally to the causes already mentioned, it is not strange that attempts at the successful manufacture of sugar at a profit were fruitless.

MANUFACTURING DATA.

Cane contracted for by the company	acres	1,200
Cane delivered to the mill	do	1,000
Weight of cane delivered	tons	6,412
Yield of cane per acre	do	6.41
Total amount of sugar made	pounds	278,687
Yield of sugar, per ton of field cane	do	43.57

By the term "field cane" is meant the cane with its blades and tops. The average amount of clean chips afforded by such cane is 75 per cent of the total weight. The amount of clean cane, therefore, entering the battery under this estimate was 4,809 tons. The yield of sugar per ton of clean cane chips was therefore nearly 58 pounds.

The sampling of the chips entering the battery was made in the usual way so as to secure a fair average of the cane worked. The analyses of these samples were commenced on the 10th of September and were continued until the close of the house on the 8th of November.

Forty-seven samples of fresh chips were analyzed with the following mean results:

In the juice.

Total solids	per cent	15.97
Sucrose	do	10.15
Glucose	do	2.14
Purity		63.56

A mere glance at these figures will show that the cane was in a very poor condition for sugar-making purposes. This was due to the causes already stated, namely, the autumnal rains, which prevented the cane from properly maturing, and the fact that the fields were planted with mixed seeds so that some of the cane was mature at a much earlier period, and doubtless the principal cause was imperfect cultivation. The poor character of the chips for sugar-making purposes is illustrated in a striking way by comparing the analyses of them with the analyses of chips from cane in other parts of the State. Considering the character of the material worked, the yield per ton must be considered as quite satisfactory.

Twenty-seven analyses of the exhausted chips were made, showing a mean percentage of sugar therein of 1.77. This result shows very poor battery work. A mean percentage of sugar in the exhausted chips of more than 0.5 per cent shows some grave defect in the method of working. This defect is usually due to imperfect chipping; the shredders become dull, allowing large pieces of cane to go through unshredded, the internal portions of which are protected from the diffusion process. With chips properly prepared and the temperature of the battery properly regulated there is no difficulty whatever in securing extraction which will leave 0.5 per cent or less of sugar in the bagasse.

Fifty analyses of average samples of the diffusion juice were made, with the following mean results:

Total solids	per cent	12.99
Sucrose	do	8.54
Glucose	do	1.67
Purity		67.39

Forty-eight analyses of the clarified juices were made, with the following mean results:

Total solids	per cent	13.23
Sucrose	do	8.91
Glucose	do	1.57
Purity		68.49

Twenty-five analyses of the sirups entering the vacuum pan were made, with the following mean results:

Total solids	per cent	38.58
Sucrose	do	25.24
Glucose	do	3.94
Purity		64.69

For convenience of reference the work of the factory was divided into three periods, namely: First period, from September 10 to 20; second period, from September 20 to October 15; third period, from October 15 to October 30, not including the last two days of the run in November. The mean data for the three periods are as follows:

Fresh chip juice.

	First period.	Second period.	Third period.
Total solids ..... per cent..	16.58	16.09	16.67
Sucrose ..... do....	10.02	10.38	11.18
Glucose ..... do....	2.68	1.81	1.84
Solids not sugar..... do....	3.94	3.90	3.65
Glucose ratio.....	26.15	17.44	16.45
Purity coefficient.....	60.43	64.51	67.67

The means for the whole season, excluding the November run, are—

Total solids	per cent..	16.32
Sucrose	do....	10.54
Glucose	do....	1.92
Solids not sugar	do....	3.86
Glucose ratio		18.22
Purity coefficient		64.56

The constant improvement of the material entering the battery from the beginning to the end of the season is strikingly illustrated by the above figures. We find the same fact true of sorghum that is illustrated in sugar cane, that the longer the season for manufacturing can be delayed the richer the material in sugar will become. With an average of 10.5 per cent. sugar in the juice and 9.45 per cent. sugar in the cane the total amount of sucrose in a ton of clean chips is 189 pounds and the amount obtained in a merchantable form of the raw sugar, as indicated above, is 58 pounds, which would amount to about 55 pounds of pure sugar.

The results illustrate the striking loss in sorghum sugar manufacture as heretofore carried on, viz, a loss of 134 pounds of sucrose for each ton of clean chips worked. This loss, as has already been pointed out repeatedly, is due to the pernicious effects of the reducing sugars and matters not sugars present in the juice, such matters, as shown by our work during the present year, having amounted to 3.86 per cent. of the weight of the juice. It is perfectly safe to say that the total loss of sugar in the molasses was almost exclusively due to the presence of these matters in the juice. It is evident at once that the financial success of sorghum sugar manufacture must follow some method of work which would largely eliminate these sources of loss.

The analytical details of the season's work follow in tabular form.

Juice from average samples of fresh chips.

Date.	Solids.	Sucrose.	Glucose.	Purity.	Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	
Sept. 10	15.93	10.45	.....	65.47	Oct. 11	15.97	9.83	2.39	61.55
Sept. 11	14.61	9.56	.....	65.43	Oct. 12	15.66	9.78	2.46	62.40
Sept. 15	18.03	11.64	1.43	64.50	Oct. 13	15.98	9.75	1.97	61.01
Sept. 16	16.98	11.19	1.58	65.90	Oct. 14	14.39	9.46	1.74	65.70
Sept. 17	17.69	10.71	3.77	60.50	Oct. 15	16.18	11.29	1.82	69.60
Sept. 18	18.11	9.05	3.86	50.00	Oct. 16	17.12	11.79	1.40	68.86
Sept. 19	14.38	6.88	3.19	47.0	Oct. 17	17.38	11.42	1.70	65.70
Sept. 20	17.82	11.05	1.50	62.0	Oct. 18	16.84	11.51	1.50	68.30
Sept. 21	16.87	10.65	1.87	63.0	Oct. 19	16.84	11.79	1.96	70.00
Sept. 23	18.72	11.75	2.02	62.76	Oct. 20	19.17	12.86	1.22	67.1
Sept. 24	10.52	6.43	1.25	61.12	Oct. 21	14.80	10.44	1.56	70.5
Sept. 25	17.28	10.54	1.69	60.90	Oct. 22	17.81	12.71	1.93	71.4
Sept. 26	15.42	9.97	1.76	64.65	Oct. 23	16.56	10.17	1.75	61.41
Sept. 27	14.87	8.16	1.88	55.6	Oct. 24	17.20	9.52	2.79	55.60
Sept. 28	18.04	7.76	.....	43.15	Oct. 26	16.03	9.92	2.28	61.88
Sept. 29	16.53	10.46	2.34	63.20	Oct. 27	17.14	11.01	2.00	63.06
Sept. 30	17.31	11.67	1.67	67.40	Oct. 28	17.29	11.00	1.95	63.27
Oct. 1	14.89	9.62	1.38	64.67	Nov. 3	16.57	9.55	1.81	51.62
Oct. 2	16.51	10.99	1.47	66.50	Nov. 4	17.24	9.16	4.72	53.13
Oct. 4	17.81	10.35	2.45	66.90	Nov. 6	15.57	9.45	2.31	60.69
Oct. 5	15.53	9.59	1.89	61.70	Nov. 7	16.47	9.41	5.27	57.12
Oct. 6	13.34	9.10	1.17	67.50	Nov. 8	16.09	9.46	4.41	58.70
Oct. 7	15.67	10.22	.....	65.20					
Oct. 8	15.89	9.44	1.31	59.00	Means..	15.97	10.15	2.14	63.56
Oct. 9	17.50	8.51	2.16	48.62					

Average samples of diffusive juice.

Date.	Solids.	Sucrose.	Glucose.	Purity.	Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	
Sept. 5	9.58	6.04	.....	63.04	Oct. 10	13.25	7.51	.....	69.2
Sept. 8	9.97	6.22	.....	62.18	Oct. 12	12.74	8.39	1.77	65.8
Sept. 9	10.35	7.27	.....	70.24	Oct. 13	12.25	8.46	1.22	69.06
Sept. 10	7.49	5.01	.....	66.78	Oct. 14	12.98	9.79	1.29	75.4
Sept. 11	10.40	6.52	.....	62.69	Oct. 15	13.27	9.66	1.49	72.8
Sept. 15	8.96	6.39	1.26	71.3	Oct. 16	12.79	9.49	1.29	74.1
Sept. 16	5.85	3.87	.406	66.1	Oct. 17	14.29	10.27	1.76	71.1
Sept. 18	9.82	5.96	3.86	50.0	Oct. 18	14.35	10.30	1.72	71.7
Sept. 19	9.27	5.39	1.41	58.1	Oct. 19	14.65	9.97	.....	68.0
Sept. 20	8.17	4.92	.563	60.2	Oct. 20	13.85	10.87	1.71	78.5
Sept. 21	8.51	5.69	1.33	67.0	Oct. 21	13.49	9.75	1.42	72.2
Sept. 23	9.46	6.40	1.03	67.70	Oct. 22	14.33	9.87	1.46	68.8
Sept. 25	9.22	5.48	1.04	59.4	Oct. 23	13.59	9.89	1.63	72.7
Sept. 26	12.32	8.37	1.48	67.93	Oct. 24	14.06	8.18	2.15	58.2
Sept. 27	13.66	9.67	1.69	70.07	Oct. 26	14.53	9.67	2.41	66.56
Sept. 28	13.73	9.67	1.91	70.4	Oct. 27	14.74	10.37	1.80	70.3
Sept. 29	12.71	8.26	1.85	65.0	Oct. 28	14.47	10.34	1.47	72.15
Sept. 30	14.80	9.62	2.05	65.0	Nov. 3	12.05	8.12	1.47	67.38
Oct. 1	13.15	8.95	1.43	67.5	Nov. 4	14.56	9.62	1.62	66.07
Oct. 2	13.35	9.13	1.79	68.3	Nov. 5	14.91	9.95	2.15	66.7
Oct. 3	11.75	7.98	1.72	67.9	Nov. 6	14.85	9.01	1.80	66.70
Oct. 4	14.20	9.49	2.34	66.9	Nov. 7	13.85	9.38	1.96	67.72
Oct. 5	14.87	8.86	1.48	59.5	Nov. 8	11.85	7.47	1.65	63.01
Oct. 6	13.05	9.03	1.64	69.2					
Oct. 8	13.83	9.69	1.78	70.1	Means..	12.99	8.54	1.67	67.39
Oct. 9	13.97	8.70	2.85	66.8					

Average samples of clarified juice.

Date.	Solids.	Sucrose.	Glucose.	Purity.	Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	
Sept. 5	9.95	6.34	.....	63.72	Oct. 11	14.71	10.91	1.04	71.3
Sept. 8	10.99	7.14	.....	64.92	Oct. 12	13.78	9.39	1.74	68.1
Sept. 9	10.68	7.42	.....	69.47	Oct. 13	12.35	8.51	.99	68.90
Sept. 10	8.71	5.80	.....	66.58	Oct. 14	14.81	10.93	1.42	73.8
Sept. 11	10.85	6.73	.....	62.03	Oct. 15	13.91	9.92	1.31	71.3
Sept. 15	8.95	5.54	1.20	61.9	Oct. 16	14.03	10.20	1.28	72.3
Sept. 16	6.41	4.00	.66	62.4	Oct. 17	14.93	10.22	1.45	68.6
Sept. 18	10.31	6.39	1.99	61.9	Oct. 18	15.09	10.60	1.33	70.2
Sept. 20	8.96	5.56	.634	62.05	Oct. 19	15.13	10.73	1.53	70.9
Sept. 22	10.96	7.62	1.11	69.50	Oct. 20	14.35	10.94	1.25	76.2
Sept. 25	10.37	7.05	1.02	67.9	Oct. 21	14.49	9.87	1.45	68.0
Sept. 26	12.78	9.65	1.37	75.58	Oct. 22	14.69	10.52	1.35	72.5
Sept. 27	14.32	10.24	1.39	71.6	Oct. 23	15.14	11.19	1.52	73.8
Sept. 28	14.97	10.01	1.85	68.0	Oct. 24	15.93	8.78	2.34	55.1
Sept. 29	13.37	8.56	1.93	64.0	Oct. 26	15.03	9.72	2.30	64.66
Sept. 30	14.09	10.01	1.66	71.0	Oct. 27	15.44	10.39	1.88	67.3
Oct. 1	14.07	9.57	1.58	73.1	Oct. 28	15.43	10.42	1.51	67.50
Oct. 2	13.97	9.44	1.41	67.5	Nov. 3	12.15	7.88	1.24	64.85
Oct. 3	13.95	8.40	1.26	60.2	Nov. 4	15.04	10.39	1.64	69.08
Oct. 4	15.01	9.91	1.88	66.0	Nov. 5	15.81	10.19	1.79	64.5
Oct. 5	15.07	9.06	1.74	60.0	Nov. 6	16.07	9.85	1.95	61.29
Oct. 6	12.80	9.18	.....	71.7	Nov. 7	14.72	9.46	1.88	64.26
Oct. 7	11.78	7.43	1.84	63.07	Nov. 8	12.72	7.60	1.66	59.74
Oct. 8	14.38	9.34	1.98	64.9					
Oct. 9	14.26	9.06	2.39	63.5	Means..	13.23	8.91	1.57	68.49

Average samples of semi-sirup.

Date.	Solids.	Sucrose.	Glucose.	Purity.	Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Sept. 5	34.63	24.33	.....	70.25	Oct. 4	35.97	21.8	5.32	60.66
Sept. 10	43.61	31.68	.....	72.64	Oct. 6	33.58	22.0	4.10	65.6
Sept. 11	29.10	19.44	.....	66.80	Oct. 8	38.69	24.0	4.67	62.03
Sept. 17	30.11	20.27	4.70	67.3	Oct. 11	34.28	21.4	5.04	51.24
Sept. 19	40.53	24.60	6.15	60.6	Oct. 12	37.32	24.2	5.50	64.75
Sept. 20	37.75	24.89	5.83	65.93	Oct. 16	33.04	21.6	3.76	65.37
Sept. 24	40.25	26.64	2.86	66.19	Oct. 18	42.90	29.2	6.34	68.06
Sept. 25	35.29	20.97	4.81	59.0	Oct. 21	32.39	22.4	3.75	69.15
Sept. 26	44.98	28.12	5.59	62.50	Oct. 26	36.18	23.2	5.38	64.11
Sept. 27	41.57	28.14	4.72	67.7	Oct. 28	37.97	26.2	4.31	68.99
Sept. 29	46.76	29.5	.....	61.0	Nov. 7	48.06	32.0	5.17	66.58
Sept. 30	41.00	27.6	3.24	67.30					
Oct. 2	42.28	26.0	5.64	61.40	Means..	38.58	25.24	3.94	64.69
Oct. 3	46.47	28.9	5.88	62.2					

Average samples of juice of exhaust chips.

Date.	Solids.	Sucrose.	Date.	Solids.	Sucrose.	Date.	Solids.	Sucrose.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*		*Per cent.*	*Per cent.*
Sept. 10	2.32	.605	Oct. 3	1.53	.54	Oct. 22	3.93	2.30
Sept. 11	2.76	1.70	Oct. 4	2.72	1.36	Oct. 23	2.47	2.25
Sept. 15	3.22	2.20	Oct. 5	2.32	.568	Oct. 24	5.26	3.57
Sept. 16	3.28	1.81	Oct. 6	1.63	1.17	Oct. 25	2.44	1.13
Sept. 17	4.49	2.29	Oct. 7	1.37	.375	Oct. 26	3.94	2.60
Sept. 18	2.31	1.33	Oct. 8	1.88	1.05	Oct. 27	5.70	2.85
Sept. 19	1.93	.911	Oct. 9	2.56	.878	Oct. 28	5.44	3.08
Sept. 20	3.02	1.60	Oct. 10	2.06	1.72	Nov. 3	3.56	2.09
Sept. 21	.....	1.05	Oct. 12	3.09	1.72	Nov. 4	3.64	1.32
Sept. 23	4.07	2.00	Oct. 13	2.87	1.41	Nov. 5	3.16	2.51
Sept. 24	2.02	.740	Oct. 14	2.21	1.10	Nov. 6	2.16	1.45
Sept. 26	2.97	1.27	Oct. 15	3.22	1.52	Nov. 7	3.44	2.01
Sept. 27	1.51	.42	Oct. 16	2.16	1.25	Nov. 8	4.66	3.28
Sept. 28	1.37	.55	Oct. 18	3.01	1.19			
Sept. 30	1.96	1.08	Oct. 19	2.26	.96	Mean...	2.91	1.77
Oct. 1	2.76	1.33	Oct. 20	4.21	2.70			
Oct. 2	2.21	1.19	Oct. 21	2.63	1.87			

Averages for three periods of season of 1890, *Topeka Sugar Works.*

FRESH CHIPS.

Date.	Degrees cor. Brix.	Sucrose.	Glucose.	Solids not sugar.	Glucose ratio.	Solid not sugar ratio.	Coefficient of purity.	Inversion.
		Per cent.	*Per cent.*	*Per cent.*				*Per cent.*
Sept. 10 to 20	16.58	10.02	2.62	3.94	26.15	32.32	60.43	.....
Sept. 20 to Oct. 15	16.09	10.38	1.81	3.90	17.44	37.57	64.51	.....
Oct. 15 to 30	16.67	11.18	1.84	3.65	16.45	32.64	67.67	.....
Averages of season	16.32	10.536	1.92	3.864	18.22	36.67	64.56	.....

DIFFUSION JUICES.

Sept. 4 to 20	8.94	5.62	1.05	2.27	18.68	25.39	62.8	.....
Sept. 20 to Oct. 15	12.77	8.56	1.69	2.52	19.74	29.44	68.5	.3331
Oct. 15 to 30	14.03	9.90	1.70	2.57	17.18	23.53	70.5	.2057
Averages of season	12.30	8.30	1.61	2.39	19.39	28.79	67.56	.....

CLARIFIED JUICES.

Sept. 4 to 20	9.53	6.10	1.31	2.12	21.47	22.24	64.00	.....
Sept. 20 to Oct. 15	13.77	9.44	1.45	2.88	15.36	30.51	68.56	.....
Oct. 15 to 30	14.89	10.13	1,57	3.19	15.49	30.50	68.03	.....
Averages of season	13.23	8.96	1.49	2.78	16.64	30.69	67.72	.....

EXHAUSTED CHIPS.

Date.	Sucrose.	Dilution.	Extraction.	Average temperature of discharged juice, 10-inch cell.	Variation of temperature.
	Per cent.	*Per cent.*	*Per cent.*	° *C.*	° *C.*
Sept. 10 to 20	1.50	84.35	85.03	52	68 to 40
Sept. 20 to Oct. 15	1.07	25.98	89.69	49	58 to 45
Oct. 15 to 30	1.69	18.82	84.88	49	54 to 44
Averages of season	1.38	32.68	87.00	50	68 to 44

Battery work at Topeka Sugar Factory.

Study of middle period of season.

Date.	Character of chip.	Temperature of discharging cell.	Degrees cor. Brix, shown by battery report.	Degrees cor. Brix, chip juice.	Dilution.	Extraction.	Sucrose in exhausted chips.	No. cells worked	Time lost.	No. cells.
		°C			*Per ct.*	*Per ct.*	*Per ct.*		*Hrs.*	*Per hr.*
Sept. 21	Fair	51	8.26	16.87	104.25	90.20	1.05	54	9.00	3.60
Sept. 23	Poor	47	10.46	17.80	70.07	84.95	1.63	71	9.50	4.89
Sept. 24	Fair	52	12.38	17.28	39.61	88.50	.74	25	8.25	1.62
Sept. 26	Poor	46	12.92	15.42	19.35	84.23	1.20	64	5.75	3.51
Sept. 27	Good	49	14.46	18.19	25.72	92.17	.70	70	5.00	3.68
Sept. 29	..do	47	12.76	16.57	30.00	93.00	.69	61	2.50	2.83
Sept. 30	...do	47	15.11	16.32	8.00	89.30	1.17	64	4.00	3.20
Oct. 1	Fair	48	13.89	16.18	17.24	89.58	1.11	46	9.50	3.17
Oct. 2	.. do	48	13.04	15.40	15.79	90.17	1.07	52	9.50	3.58
Oct. 3	...do	60	11.88	.....	.....	.....	.54	23	.....	.....
Oct. 4	.. do	49	14.19	17.81	25.51	87.67	1.28	38	13.50	3.62
Oct. 5	Good	51	14.45	15.53*	7.26*	94.10*	.57	77	1.75	3.01
Oct. 6	...do	52	12.33	.....	.....	87.00	1.17	43	8.00	2.75
Oct. 7	...do	48	12.63	15.50	22.72	95.09	.46	71	3.50	3.30
Oct. 8	...do	50	14.48	16.91	16.77	90.20	.93	77	5.00	4.05
Oct. 9	...do	50	14.20	16.56	16.62	90.80	.88	69	1.50	3.07
Oct. 11	Fair	47	13.43	15.97	11.46	86.33	1.43	81	2.50	3.77
Oct. 12	Poor	48	13.55	15.66	15.57	80.57	1.92	41	13.50	3.62
Oct. 13	Good	52	12.44	15.98	28.45	90.97	.96	74	4.00	3.70
Oct. 14	Fair	50	13.07	14.39	10 17	85.52	1.37	84	5.00	4.42
Oct. 15	...do	51	13.37	16.18	20.26	87.53	1.41	104	4.00	5.20
Totals and means		50	13.01	16.34	25.59	88.89	1.01	1,289	135.25	3.49
Maxima		60	15.11	18.19	104.25	95.09	1.92	104	13.50	5.20
Minima		46	8.26	14.39	7.26*	80.57	.54	23	1.50	1.62

Time lost, hours:
Per cent.=26.78 total loss.
— 8.33 per cent. loss or 2 hours out of 24.

=18.45 loss on account of works.

OPERATIONS AT CONWAY SPRINGS, KANSAS.

The large factory at Conway Springs having been abandoned after two seasons of unsuccessful operation, the only work which was done at that place consisted in an attempt to make sugar in a small way by milling and open evaporation.

The results, easily predicted, only serve as another illustration of the futility of attempting sorghum sugar manufacture without any of the appliances or conditions necessary to success.

The promoters of the enterprise, however, desiring to have some chemical work done, a chemist was employed for the season. Chemical work was commenced on the 25th of September, and practically concluded on the 25th of October. During this time the mill was in operation only at irregular intervals, and there was found a total lack of proper preparation. The whole process, in fact, was characterized by unscientific methods.

The cane showed a great deterioration from the quality produced in the preceding years, but the cause of this inferiority is not clearly evident.

Forty-two analyses of samples of cane from the field showed in the juice the following percentages:

Total solids	per cent...	18.1
Sucrose	do....	10.4
Glucose	do....	4.4
Purity		57.5

Twenty-four samples of juices taken from the mill during the period it was in operation showed the following numbers:

Total solids	per cent..	16.5
Sucrose	do....	9.5
Glucose	do....	4.5
Purity		57.6

The unfitness of these canes for sugar making purposes is at once evident. As a natural result of the poor quality of the raw material and inadequate methods of manufacture pursued no sugar at all was produced, and even the molasses made was of a very inferior quality.

The chemical work at Conway Springs was conducted by Mr. M. C. Mechem. Following are the results in detail:

Average samples of canes from fields.

No.	Date.	Solids.	Sucrose.	Glucose.	Purity.	Remarks.
		Per cent.	*Per cent.*	*Per cent.*		
1	Sept. 25	17.0	11.5	.....	65.0	Green orange.
2	Sept. 25	21.4	3.8	.....	17.0	Amber, overripe, cut 4 days.
3	Sept. 25	24.8	1.8	.....	7.4	Do.
4	Sept. 25	15.7	10.3	.....	67.0	Green orange.
5	Sept. 25	24.1	14.7	.....	60.9	Amber.
6	Sept. 25	19.1	13.9	.....	70.8	Orange.
7	Sept. 25	16.5	11.0	.....	63.0	Do.
8	Oct. 3 (?)	15.6	9.6	.....	61.3	Orange, half ripe.
9	.....	17.8	11.8	.....	67.0	Do.
10	.....	17.5	12.2	.....	69.7	Honey dew, ripe.
11	.....	18.1	13.1	.....	72.1	Orange, half ripe.
12	.....	13.2	6.4	.....	48.8	Orange, green.
13	.....	15.1	9.9	.....	65.0	Do.
14	.....	17.3	10.4	3.30	60.0	Orange, half ripe.
15	.....	17.8	12.0	2.10	67.4	Orange, green.
16	.....	15.3	9.4	2.70	61.4	Do.
17	.....	15.5	9.7	2.60	62.4	Do.
18	.....	.....	.....	.....	.....	
19	.....	.....	.....	.....	.....	
20	.....	18.5	13.1	2.8	70.8	Orange, half ripe.
21	.....	15.7	9.2	6.5	58.5	Orange, green.
22	.....	16.8	11.5	3.7	68.3	Orange, half ripe.
23	.....	21.8	14.8	3.8	67.8	Orange, ripe.
24	.....	18.5	8.6	7.1	46.4	Orange, half ripe, cut 3 days.
25	.....	18.0	13.4	2.5	74.4	Orange, just cut.
26	.....	17.5	12.4	2.9	70.8	Do.
27	.....	16.5	11.0	3.3	66.6	Do.
28	.....	15.3	9.8	2.9	62.0	Orange, green.
29	.....	24.6	8.0	10.0	32.5	Same as No. 23, had been cut 24 hours.
30	.....	22.5	7.5	10.5	33.3	Orange, half ripe, cut 4 days.
31	.....	15.1	9.3	4.3	61.5	Orange, green, just cut.
32	.....	16.1	10.5	4.1	65.2	Do.
33	.....	17.7	11.3	3.3	63.8	Do.
34	.....	15.7	8.8	3.8	56.0	Do.
35	.....	24.6	8.2	10.8	33.3	Same as 23 and 29, cut 48 hours.
36	.....	22.4	4.5	12.5	20.0	Orange, ripe, cut 5 days.
37	.....	15.8	10.7	3.1	67.7	Orange, green, just cut.
38	.....	18.1	13.4	2.2	74.0	Orange, ripe, just cut.
39	.....	18.0	14.5	1.5	80.5	Do.
40	Oct. 19	16.9	11.5	2.1	68.0	Orange, half ripe.
41	.....	15.7	10.7	3.8	68.1	Orange, green.
42	.....	17.6	13.0	1.4	73.8	Orange.
Means		18.1	10.4	4.4	57.5	

Average sample of mill juices, Conway Springs.

No.	Date.	Solids.	Sucrose.	Glucose.	Purity.	Remarks.
		Per cent.	*Per cent.*	*Per cent.*		
1	Oct. 19	16.6	11.2	2.1	67.4	
2	Oct. 19	15.6	9.8	2.8	63.8	
3	Oct. 19	16.4	8.7	2.0	34.7	
4	Oct. 19	15.3	8.4	3.1	54.9	
5	.....	16.5	10.5	4.1	63.6	
6	.....	15.9	10.4	3.0	65.5	
7	.....	17.2	10.9	4.0	63.3	
8	.....	17.3	10.7	4.3	61.8	
9	.....	18.0	11.5	3.0	63.3	
10	.....	13.1	9.7	3.9	74.0	
11	.....	15.8	9.7	5.4	61.3	
12	.....	14.8	9.4	4.4	63.5	
13	.....	16.3	10.7	4.2	66.3	
14	.....	16.5	10.7	3.7	64.8	
15	.....	16.2	9.7	6.1	60.0	
16	.....	13.5	8.0	4.1	69.2	
17	.....	19.4	8.2	10.0	42.2	Cut 6 days and piled in field.
18	.....	18.1	10.0	7.1	55.2	Cut 7 days and piled in field.
19	.....	21.0	10.0	9.0	47.6	Cut 8 days and piled in field.
20	.....	18.5	9.5	4.1	51.5	Cut 9 days and piled in field.
21	.....	18.0	7.6	5.3	42.2	Cut 10 days and piled in field.
22	.....	17.6	6.0	6.2	34.0	Cut 1 day after frost.
23	.....	14.8	7.5	3.3	50.6	Cut 2 days after frost.
24	.....	14.2	8.5	3.4	59.8	Frosted twice.
Means		16.5	9.5	4.5	57.6	

Average samples of clarified juice, Conway Springs.

Number.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*	
1.....	17.8	10.7	3.8	60.1
2.....	17.7	9.0	2.5	50.8
3.....	18.4	10.7	4.1	58.2
4.....	18.9	12.1	5.0	64.0
5.....	18.8	10.0	6.1	50.3
6.....	18.3	9.7	5.4	54.1
7.....	16.2	10.2	4.1	63.0
8.....	16.4	9.0	4.7	54.8
9.....	22.0	5.5	7.5	25.0
10.....	18.9	6.4	10.5	33.8
11.....	16.3	8.5	3.0	62.1
12.....	21.2	5.8	3.1	27.3
13.....	18.1	7.7	4.2	42.5
14	15.1	8.1	3.4	53.5
Means ..	18.2	8.8	4.8	48.4

Average samples of molasses, Conway Springs.

Number.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*	
1.....	72.5	46.2	13.69	57.3
2.....	84.8	48.0	12.50	56.6
3.....	90.4	52.6	15.30	58.2
4.....	87.2	32.8	31.00	37.61
Means..	83.7	44.9	18.12	.....

OPERATIONS AT MEDICINE LODGE, KANSAS.

The chemical work at Medicine Lodge was in charge of Mr. T. F. Sanborn, assisted by Mr. E. G. Runyan.

Manufacturing operations at Medicine Lodge commenced on the 18th of August and continued until the end of October. The machinery in use last year had been thoroughly overhauled and placed in excellent working order. No delays of any consequence were experienced in working the apparatus, and, for the first time in the history of the manufacture of sorghum surgar, the losses due to delays were reduced to a minimum.

The crop of sorghum cane was grown in a season of great drought, which prevented the corn crop from maturing. The evil effects of the drought were felt also on the cane, but in spite of it a crop of considerable magnitude was produced. On the 25th of August the long period of drought and hot winds was broken by copious rains, and from that time until the end of the manufacturing season frequent rains fell. The cane in the fields readily ripened after the rains, and many fields which were considered worthless redeemed themselves and produced considerable quantities of merchantable cane. The high red loam of the uplands produced a better crop than the low bottom lands, both in quantity and quality. In addition to this the first frost affected only the bottom lands, and the cane on the uplands had fully three week's longer season on this account than the cane on the low lands.

The results of the mean analyses of the cane chips entering the battery for the season show the following numbers:

In the juice.

Total solids	per cent	18.29
Sucrose	do	12.62
Glucose	do	2.24
Purity		69.86

The exhausted chips contained 0.81 per cent sucrose; the mean polarization of the first sugars made was 91.8 and of the second sugars made 91.2. The mean percentage of sugar in the cane extracted for the whole season was 93.6. The mean percentage of marc or fiber in the cane was 12.2 per cent.

Nine hundred and forty-one miscellaneous analyses of the cane from farmers in different parts of the county were made with the following mean results:

In the juice.

Total solids	per cent	19.83
Sucrose	do	15.12
Glucose	do	2.21
Purity		71.01

The summary of the season's work will give a fair idea of what was accomplished:

Working days		35
Clean cane worked	tons	3,957
First sugar obtained, per ton of clean cane	pounds	101.1
Second sugar obtained, per ton of clean cane	do	22.5
Total yield, per ton of clean cane	do	123.6
Sugar obtained, based on total amount in cane	per ct	51.4
Molasses made, per ton of clean cane	gallons	13.8
Total weight of sugar made	pounds	489,357

Summary of work on early cane.

Cane diffused	tons		1,249.635
Cane diffused	pounds		2,499,270
Sugar obtained:			
Firsts	pounds	103,110	
Seconds	do	19,980	
Sugar obtained total	pounds		123,090
First sugar, per ton of cane	pounds	82.5	
Second sugar, per ton of cane	pounds	16	
Total sugar, per ton of cane	pounds		98.5
Molasses obtained	gallons		12,470
Molasses obtained	pounds		149,640
Molasses obtained, per ton of cane	gallons		9.9
Molasses obtained, per ton of cane	pounds		118.8
Molasses obtained, per 1,000 pounds sugar	gallons		101.6
Molasses obtained, per 1,000 pounds sugar	pounds		1,219.2

Summary of work on late cane.

Number of working days			26
Clean cane diffused	tons		2,707.552
Clean cane diffused	pounds		5,415,104
Per cent juice in clean cane			87.8
Sucrose in clean cane	pounds		651,708
Glucose in clean cane	do		103,720
Available sugar in clean cane (approximate)	do		496,128
Sugar obtained per ton of clean cane:			
Firsts	pounds	109.6	
Seconds	do	25.7	
Total	pounds		135.3
Sugar obtained:			
Firsts		296,926	
Seconds		69,341	
Total	pounds		366,267
Sugar obtained, per cent sucrose in cane			56.2
Molasses obtained	gallons		42,162
Molasses obtained, per ton of clean cane	do		15.4
Molasses obtained, per ton of clean cane	pounds		184.4
Molasses obtained, per 1,000 pounds sugar	do		1,368.5
Sucrose lost in exhaust chips	pounds		44,854

Sucrose inverted in battery	pounds..	6,146
Mechanical loss and inversion not noted	do....	43,359
Total loss	do....	94,359
Sucrose in molasses	pounds..	191,082
Total loss, per cent. sucrose obtained		25.8
Total loss, per ton of clean cane		34.8
Total loss, per cent of sucrose in cane		14.4

Summary of work for season.

Number of working days			35
Clean cane diffused	tons..		3,957.187
Clean cane diffused	pounds..		7,914,374
Topped cane diffused	tons..		4,767.695
Topped cane diffused	pounds..		9,535,390
Per cent leaves and trash in topped cane			17
Per cent juice in clean cane			87.8
Sucrose in cane	pounds..		876,521
Glucose in cane	do...		155,270
Available sugar in cane (approximate)	do...		643,154
Sugar obtained, per ton of clean cane:			
Firsts	pounds..	101.1	
Seconds	do...	22.5	
Total	pounds..		123.6
Sugar obtained per ton of topped cane:			
Firsts	pounds..	83.9	
Seconds	do...	18.7	
Total	pounds..		102.6
Commercial sugar obtained:			
Firsts	pounds..	400,036	
Seconds	do...	59,321	
Total			459,357
Sugar obtained, per cent of sucrose in cane			55.9
Molasses obtained	gallons..		54,632
Molasses obtained, per ton of clean cane	do...		13.8
Molasses obtained, per ton of clean cane	pounds..		165.6
Molasses, obtained, per 1,000 pounds sugar	do...		1,332
Losses:			
Sucrose lost in exhausted chips	pounds..		64,106
Sucrose inverted in battery	do...		9,219
Mechanical loss and inversion not noted	do...		63,538
Total loss for season			136,863
Sucrose in molasses	pounds..		250,301
Total loss, per cent of sucrose obtained			27.9
Total loss, per ton of clean cane			34.6
Total loss, per ton of topped cane			28.6
Total loss, per cent of sucrose in cane			15.6
Cane harvested	acres..		1,200

Comparison of cane grown on high and low ground—Results of 507 analyses.

	High.	Low.
Sucrose:		
Mean	15.13	12.84
Maxima	18.45	16.95
Minima	11.20	6.40
Purity:		
Mean	72.81	70.77
Maxima	84.95	80.20
Minima	58.17	58.29

The details of the analytical work are found in the following tables:

Fresh chips.

Date.	Solids.	Sucrose.	Glucose.	Purity.	Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	
Sept. 16	18.55	11.79	2.79	63.66	Oct. 7	17.99	12.19	2.37	68.76
Sept. 17	18.14	12.31	2.34	67.47	Oct. 9	18.47	13.31	2.31	73.06
Sept. 18	18.13	11.69	2.03	64.47	Oct. 10	18.41	12.04	2.26	66.39
Sept. 19	17.80	12.76	2.09	71.69	Oct. 11	18.28	13.00	2.18	71.11
Sept. 20	18.24	11.81	2.48	64.69	Oct. 12	18.18	13.94	1.43	76.67
Sept. 25	19.10	12.27	2.39	64.24	Oct. 13	19.31	13.59	2.09	70.38
Sept. 26	18.18	13.30	2.22	73.16	Oct. 14	18.73	13.04	2.28	70.12
Sept. 27	17.77	12.06	2.11	67.86	Oct. 15	19.60	14.08	2.26	71.43
Sept. 29	17.99	11.68	2.01	65.01	Oct. 16	18.81	13.87	2.31	73.73
Sept. 30	17.94	12.04	2.20	67.32	Oct. 17	18.37	12.86	2.28	70.00
Oct. 1	17.17	10.69	2.17	64.55	Oct. 18	18.53	13.19	2.27	71.19
Oct. 2	17.84	12.89	2.24	73.35					
Oct. 3	18.31	12.69	2.23	69.31	Mean...	18.29	12.62	2.24	69.86
Oct. 4	17.87	12.07	2.24	68.23	Maxima.	19.60	14.24	2.64	78.41
Oct. 6	18.03	14.24	2.64	78.41	Minima.	17.17	10.69	1.43	63.66

Diffusion juices.

Date.	Solids.	Sucrose.	Glucose.	Purity.	Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*			*Per cent.*	*Percent.*	*Per cent.*	
Sept. 16	11.54	7.68	1.74	67.55	Oct. 7	10.81	7.35	1.02	67.99
Sept. 17	11.80	7.90	1.38	66.95	Oct. 9	10.09	7.00	1.00	69.37
Sept. 18	11.22	7.50	1.43	67.84	Oct. 10	10.29	7.32	1.07	71.13
Sept. 19	10.67	7.23	1.23	67.76	Oct. 11	10.09	7.32	1.09	72.54
Sept. 20	10.29	7.36	1.07	71.52	Oct. 12	10.23	7.67	.84	74.94
Sept. 25	10.19	7.21	1.09	70.75	Oct. 13	11.72	8.46	1.01	72.18
Sept. 26	10.39	7.31	1.03	70.35	Oct. 14	10.29	7.67	.93	74.34
Sept. 27	9.20	6.73	1.09	71.82	Oct. 15	10.25	7.44	1.02	72.59
Sept. 29	9.54	6.67	.86	76.29	Oct. 16	10.69	7.36	.98	67.84
Sept. 30	9.67	7.11	1.19	73.52	Oct. 17	9.60	7.02	.93	74.55
Oct. 1	10.15	6.71	1.09	66.11	Oct. 18	10.19	7.46	1.05	73.20
Oct. 2	10.93	7.37	1.04	67.43					
Oct. 3	11.45	7.12	1.08	62.09	Mean...	10.25	7.36	1.09	67.84
Oct. 4	10.71	7.19	1.09	67.13	Maxima.	11.80	8.46	1.74	74.94
Oct. 6	11.75	7.96	1.03	65.57	Minima.	9.20	6.67	.84	62.09

Clarified juices.

Date.	Solids.	Sucrose.	Glucose.	Purity.	Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	
Sept. 16	12.15	8.29	2.07	68.26	Oct. 7	11.25	7.66	1.14	68.09
Sept. 17	12.70	7.51	1.39	67.02	Oct. 9	10.95	7.58	1.12	69.31
Sept. 18	12.03	8.09	1.40	67.31	Oct. 10	10.59	7.42	.99	70.16
Sept. 19	9.51	6.83	1.26	67.23	Oct. 11	10.42	7.64	1.20	73.39
Sept. 20	11.04	7.88	1.07	71.75	Oct. 12	10.37	8.38	.77	80.80
Sept. 25	10.64	7.54	1.09	71.00	Oct. 13	11.55	8.61	1.05	72.02
Sept. 26	11.16	7.83	1.07	70.58	Oct. 14	10.69	7.69	.97	74.63
Sept. 27	10.61	6.42	1.09	62.02	Oct. 15	10.55	7.38	1.13	70.02
Sept. 29	10.04	6.85	.94	68.23	Oct. 16	11.09	7.45	1.06	67.83
Sept. 30	10.03	7.43	1.21	74.11	Oct. 17	10.10	7.29	1.05	72.22
Oct. 1	10.03	6.62	1.11	66.14	Oct. 18	10.89	7.84	1.19	73.41
Oct. 2	11.33	7.64	1.07	67.44					
Oct. 3	11.19	7.10	1.09	63.51	Mean...	11.17	7.59	1.14	68.55
Oct. 4	11.05	7.39	1.22	67.00	Maxima.	12.70	8.38	2.07	80.80
Oct. 6	12.11	7.79	1.07	64.32	Minima.	9.51	6.42	.77	62.02

Semisiraps.

Date.	Solids.	Sucrose.	Glucose.	Purity.	Date.	Solids.	Sucrose.	Glucose.	Purity.
	Per cent.	*Per cent.*	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	
Sept. 16	36.94	25.5	5.98	69.01	Oct. 7	39.27	27.8	4.42	69.20
Sept. 17	46.20	31.3	4.80	67.80	Oct. 9	40.53	28.3	4.30	69.90
Sept. 18	35.58	23.8	4.61	67.00	Oct. 10	34.28	25 5	4 17	74.11
Sept. 19	34.62	25.5	4.21	67.85	Oct. 12	44.62	35.2	2.99	78.88
Sept. 20	39.27	27.5	4.01	72.73	Oct. 13	43.00	31.5	4.02	73.31
Sept. 25	37.10	26.6	3.85	71.71	Oct. 14	40.03	29.6	3.98	73.92
Sept. 26	36.67	26.8	4.11	73 33	Oct. 15	38.15	27.9	4.00	73.11
Sept. 27	32.41	22.4	4.21	69.29	Oct. 16	40.17	27.7	3.97	69.21
Sept. 29	43.20	30.5	4.17	70.70	Oct. 17	36.96	27.3	4.19	73.82
Sept. 30	36.98	27.4	4.10	74.20	Oct. 18	45.70	33.8	4.03	74.07
Oct. 1	35.20	23.6	4.26	67.11					
Oct. 2	37.88	26.5	4.01	69.81	Mean...	37.88	26.5	4.17	70.18
Oct. 3	43.30	28.4	4.19	65.21	Maxima	46.20	35.2	5.98	78.88
Oct. 6	40.43	25.6	3.93	63.10	Minima	32.41	22.7	2.99	63.10

Date.	Masse cuites.						Molasses.						Sugars.	Number of strikes represented by sample.
	Solids.	Sucrose.		Glucose.	Purity.		Solids.	Sucrose.		Glucose.	Purity.		Sucrose.	
		Single polarization.	Double polarization.		On single polarization.	On double polarization.		Single polarization.	Double polarization.		On single polarization.	On double polarization.		
	Per cent.			*Per cent.*			*Per cent.*			*Per cent.*			*Per cent.*	
Sept. 16	94.31	61.61	63.40	17.08	65.32	67.22								Four strikes from run on early cane.
Sept. 18													92.3	Do.
Sept. 19	94.01	64 82	66.31	16.03	68.95	72.66	81.98	41.06	45.31	25.13	50.08	55.28	90.8	Four strikes.
Sept. 24	88.11	57.12	61.03	18.22	64.83	69.38	82.03	38.19	44.62	22.02	46.43	54.38	91.2	Three strikes of "seconds."
Sept. 25													92.1	First sugar.
Sept. 26													88.3	"Lumps" from sieve.
Sept. 26	95.00	60.02	63.21	17.13	63.18	66.52							92.0	Five strikes.
Sept. 26	85.85	50.81	54.32	18.27	59.18	62.68	82.32	43.02	46.01	20.22	52.26	55.88	90.8	Second product from above.
Sept. 30	94.88	60.84	62.03	16.24	64.12	65.36							91.3	Five strikes.
Oct. 5	86.03	54.11	58.20	18.03	62.90	67.65	83.01	43.31	46.92	22.81	52.18	56.52	91.6	Second product from above.
Oct. 5	94.13	60.22	63.85	17.38	63.96	67.82							92.9	Four strikes.
Oct. 7	86.12	54.19	57.23	18.10	61.63	65.17	81.26	42.18	45.23	21.38	51.90	55.66	91.8	Second product from above.
Oct. 10	92.59	59.10	60.88	16.21	63.83	65.75							92.7	Two strikes.
Oct. 15	86.20	55.17	59.01	18.29	64.00	68.46	82.07	41.23	45.02	22.55	50.23	54.87	90.9	Second product from above.
Oct. 15													90.9	Second sugar.
Oct. 15	94.07	59.38	62.03	16.43	63.12	65.94							91.5	Five strikes.
Oct. 17	84.93	53.71	56.83	18.02	63.24	66.91	81.63	42.61	44.73	21.03	52.19	54.78	91.3	Second product from above.
Oct. 20	93.92	59.98	62.02	17.08	63.86	66.04							92.2	Two strikes.
Oct. 27	86.21	54.16	57.29	18.19	62.83	66.48	82.21	42.02	45.02	21.75	51.11	54.60	90.8	Second product from above.
Oct. 30	93.99	59.52	60.93	16.10	63.32	64.82							91.7	Three strikes.
Oct. 30	86.02	54.43	57.63	18.00	63.28	66.99	82.02	43.55	46.13	22.08	53.09	56.24	90.8	Second product from above.
Oct. 31	94.17	61.24	64.00	17.32	65.01	67.85							90.9	One strike.
Mean	94.11	60.61	62.86	16.69	64.40	67.02								First masse cuites.
Mean	86.19	54.22	57.69	18.14	62.90	66.41								Second masse cuites.
Mean	82.16	42.13	46.44	22.11	51.27	55.35								Final molasses.
Mean													91.8	First sugars.
Mean													91.2	Second sugars.

Exhausted chips.

Date.	Solids.	Sucrose.	Date.	Solids.	Sucrose.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Sept. 16..	2.03	.96	Oct. 7 ...	1.26	.65
Sept. 17..	2.20	.56	Oct. 9 ...	2.01	.93
Sept. 18..	1.57	1.05	Oct. 10..	2.02	.72
Sept. 19..	1.67	1.20	Oct. 11 ..	1.61	.62
Sept. 20..	2.07	.99	Oct. 12 ..	2.17	.51
Sept. 25	2.06	.76	Oct. 13 ..	1.12	.41
Sept. 26..	2.00	.78	Oct. 14 ..	2.12	.62
Sept. 27.	2.41	.72	Oct. 15...	1.46	.57
Sept. 29..	2.18	.92	Oct. 16...	.92	.37
Sept. 30..	2.06	1.18	Oct. 17...	1.68	.56
Oct. 1....	2.22	1.18	Oct. 18...	1.91	.72
Oct. 2....	2.26	1.04			
Oct. 3....	2.06	.93	Mean...	1.88	.81
Oct. 4 ..	2.21	.72	Maxima-	2.60	1.20
Oct. 6....	1.76	.76	Minima.	.92	.37

GENERAL RESULTS OF MANUFACTURING WORK.

SMALL FACTORIES.

It is to be regretted that certain hallucinations seem to constantly follow the development of the sorghum sugar industry. This Department has pointed out repeatedly the insurmountable difficulties attending the production of sorghum sugar in a small way and with crude apparatus and unscientific methods. The record of the past season at the various points where the Department was represented by its chemists tends to confirm the views in this regard so often expressed heretofore. Thus the development of this industry has had to contend not only with natural difficulties, but with the discouragement attending numerous failures, although such failures were altogether due to causes which would have resulted as badly in connection with any other industry. In some cases, as in the experiment at Conway Springs, for instance, the promoters testified to the honesty of their convictions by investing their own private funds without any public aid. While such an investment is certain to be followed by financial loss, what is far worse from a public point of view, is that it will prejudice the community against the the whole business, and prevent people from viewing in the proper light processes which really give promise of success.

It is evidently the duty of the Department to caution farmers, and to reiterate what has been so often stated, that with our present knowledge, and with the present degree of development of the sorghum cane, it is not practicable to produce sugar profitably in a small way and without an ample and suitable equipment. That a good article of table sirup can be made with moderate facilities and profitably has long been known, and I conceive it to be the duty of the Department to encourage such work as that, and to discourage in every possible way attempts to make sugar under conditions and with apparatus suitable only for the manufacture of sirup. It is unfortunate that in spite of the unsatisfactory results a glowing report has been published of the

season's work at Conway Springs, and still more unfortunate to find it copied in an influential sugar journal without any comment whatever, thus lending to it an air of authority which it is feared may prove to some extent injurious.

If the alcohol method of treating sirups should prove to be a success, it might then be profitable in some localities to make a thick sirup in some small way for delivery to a central factory. Such a method might be advisable in cases where cane would otherwise have to be hauled a long distance to the central factory. These possibilities, however, are still in the future, and do not call for discussion at the present time.

LARGE FACTORIES.

After so many years of experiment and endeavor no really first-class factory has yet been constructed for making sorghum sugar. The large factories which have been operated have been always hastily and often imperfectly constructed, and, as a result, their operations have been atended with costly and disastrous delays.

The reports of the chemists from all these factories, with one exception, have contained accounts of these disasters, but so often have they been recorded, that to avoid a wearisome iteration in this bulletin they have been mostly omitted.

For economical purposes, the capacity of a factory must be definitely known, and it must be ready to do its daily work with regularity. This accomplished, a proper amount of raw material can be furnished each day and the cost of operation be reduced to a minimum. Each part of the house must be capable of doing its full share of the work, since the daily capacity of a factory is that of its weakest part.

Through costly and often ruinous experiences the sorghum sugar industry has slowly advanced, until now the soil and climatic conditions favorable to the growth of the plant are clearly understood, and the mechanical appliances necessary to its successful manufacture well established. Not in a remodeling of old factories, but in new ones, built with ample time and capital, and operated under skilled supervision, will future successes be obtained.

FUNCTIONS OF EXPERIMENTAL WORK.

One of the chief causes of delay in the advancement of the sorghum-sugar industry has been due to a misapprehension of the true functions of experimental work. There has been a constant demand that the experiments of the Department should be conducted on a manufacturing scale and in connection with a factory in active operation.

The difficulties which attend such a connection of experiment with business can only be appreciated by one who has been compelled by the exigencies of the public service to endure their burdens.

The fundamental requirement of experimental work is the ability to control it and change its conditions. This power is wholly wanting during the course of a sugar-manufacturing campaign. All energies are then enlisted in the work of saving the crop, and the requirements of experiment receive little attention.

Experimental work should be wholly freed from all entangling manufacturing alliances. Otherwise, instead of leading to sound and lasting results, it usually becomes a factory farce.

There is yet much experimental work to do in establishing a sugar industry in this country, and to attain the highest results it must be free from all such impediments to its thorough prosecution.

RECORD OF WORK IN CANE IMPROVEMENT.

CULTURE EXPERIMENTS AT MEDICINE LODGE, KANSAS.

Interesting observations were made on the effect of the drought upon the different varieties of cane. The Early Orange and Link's Hybrid gave about the same tonnage under similar conditions and also had about the same content of sugar. If there was any advantage it was in favor of the Link's Hybrid. The varieties Undendebule and Honey Dew gave disappointing results; the tonnage was light, sucrose and purity low, and the cane rapidly deteriorated after a light frost. A new variety of cane, which may be called, provisionally, Medicine Lodge Orange, made a splendid showing. The seed head of this variety is small, compact, and does not spread or open on reaching maturity. The stalk is perfectly formed and resembles very nearly that of the Early Orange, from which it can be distinguished only by its earlier ripening. It contains a high percentage of sucrose, low glucose, and endures a dry season remarkably well. It ripens in from 90 to 100 days from the time of planting. It is also hardy and does not deteriorate rapidly after frosts.

The Black African was one of the best varieties tested during the season. This variety not only has high sucrose and purity, and low glucose, but is a large cane and endures drought well. Its tonnage was nearly double that of the other varieties and it maintained its high percentage of sucrose longer than any other variety tried.

As a result of the agricultural experience of the season, it seems best to plant only the early maturing varieties on the lowlands while the late maturing varieties should be planted on the uplands.

In regard to the analyses of the Link's Hybrid variety the means of 413 analyses show the following numbers:

In the juice.

Total solids	per cent	19.72
Sucrose	do	13.59
Glucose	do	1.85
Purity		70.00

Four hundred and sixty-two analyses of the Early Orange during the season show the following data:

In the juice.

Total solids	per cent	20.20
Sucrose	do	13.20
Glucose	do	1.96
Purity		65.24

Eighty-seven analyses of the Medicine Lodge Orange gave the following data:

In the juice.

Total solids	per cent	20.18
Sucrose	do	15.60
Glucose	do	1.87
Purity		78.82

Thirteen analyses of the Undendebule gave the following data:

In the juice.

Total solids	per cent	18.80
Sucrose	do	12.45
Purity		65.93

Thirteen analyses of Honey Dew showed for the season the following results:

In the juice.

Total solids	per cent	17.42
Sucrose	do	11.43
Glucose	do	2.98
Purity		64.19

Following are the mean analyses of the Black African for the month of November:

In the juice.

Total solids	per cent	19.88
Sucrose	do	13.90
Glucose	do	2.04
Purity		71.98

Samples of cane were taken from 1,973 loads brought to the factory and examined with the following mean results:

In the juice.

Total solids	per cent	19.31
Sucrose	do	13.30
Purity		69.14

CULTURE EXPERIMENTS AT STERLING, KANSAS.

I was directed to continue at Sterling the culture work in sorghum which had given such good results in former years.

The personal oversight of the work was again committed to Mr. A. A. Denton, whose sound judgment and great industry and enthusiasm had already been so fruitful of good to the sorghum-sugar industry. Mr. Denton was instructed to continue the line of investigations pursued in former years, and to note all facts which appeared to be of any value to the further progress of the industry. The details of the work were left entirely to his own supervision.

Dr. C. A. Crampton, who had rendered such valuable services to the industry in conjuction with Mr. Denton in former years, having retired from the Department to enter the scientific service of the Treasury Department, the chemical part of the work was placed in charge of Mr. K. P. McElroy and a competent corps of assistants.

The substance of the report following was prepared jointly by Messrs. Denton and McElroy, and I have arranged it with only such changes as the demands of brevity and the results of contemporaneous investigations have required:

The experimental work of the Department at Sterling was continued during the year 1890 on the same general lines of work as those followed in previous years. The whole year was exceptionally dry. Planting was commenced on the 1st of May and finished on the 23d. Before the last of the planting was completed the ground had become so dry that the seed of the last lots planted remained for a long time in the ground without germinating. Not only did this cause a late maturity of the canes whose germination had been deferred, but also produced an uneven ripening of all the plots thus affected. Some of the seed which germinated as soon as planted produced canes ripening long before those from the delayed germination. Planting was done by hand and the seed covered by a hoe.

The land varied widely in quality from fairly fertile spots to barren sandy knolls. Much of it had not been in cultivation for several years, and part of it had been in sorghum for many years. In addition to these disadvantages of soil and season, a severe frost on the 13th of September killed all the cane in the greater part of the experimental plots. This frost was almost a month earlier than the average of the locality. After the frost the working force of the station was brought down two-thirds, and the total amount of work done was probably only about one-third what it would have been had the frost been delayed for another month. In many of the plots, however, the analyses were kept up for some time after the frost, selecting for this purpose stalks here and there which still showed green leaves. In some cases the canes

which had been frostbitten rapidly deterioriated, and in no case did they improve, but in some instances they remained quite stationary in quality for a considerable length of time. It was noticed in many cases that the canes retained their sugar content in quite a constant manner for five weeks after the frost had destroyed nearly all the leaves. The comparison of varieties under such circumstances must be more or less unreliable, and hence the analytical work of the station is not as indicative in its results as it was during previous years. The experimental plots occupied in all about 165 acres. The different plots were sowed in plots 25 feet wide, leaving about 25 feet between them to avoid mixing. This is probably not a sufficient distance, but on account of the large number of plots with which it was desired to experiment it was not possible to plant them farther apart without extending to undue proportions the total area under cultivation.

One hundred and twenty-seven plots were planted with seeds from foreign countries, received through the Department of State in response to a request from the Department of Agriculture. Two hundred plots were planted with seed selected at the station last year by the analyses of single canes. Twenty-six plots were planted from seeds which were received from Dr. Peter Collier, director of the Experiment Station at Geneva, New York. Four hundred and fifty-five plots were planted with seeds from canes which showed evidences of being crosses of Link's Hybrid and Early Amber. Each of these plots was planted with seed from a single head, and were grown in the hope of finding among them canes showing new and desirable qualities. Some of these plots gave remarkably fine canes of new types having from 14 to 16 per cent of sugar, while others were inferior in every respect to each of the parent forms. In all, twenty of these plots seemed sufficiently good to justify preservation, and the seed was saved from them for future growth.

All the one hundred and fifty-three plots planted with foreign seed, including two varieties, unnamed, from Australia, produced fine canes of good quality.

Of the various crosses first selected in 1888, planted in 1889 and again in 1890, several having proved unusually good during the three years of trial, will be retained for further experiment. Most of these new varieties are now well established and uniform in their characteristics, but there are some which still show a persistent tendency to reversion. Special data which were obtained with the Colman cane and with numbers 160, 161, and 289, are of such a character as to fully justify the whole of the labor which has been expended by the Department at the station in the development of new varieties from crosses. These four varieties possess qualities for sugar-making superior to all other known varieties of sorghum, and these characteristics have been secured by careful attention to scientific principles of selection and propagation which have been practiced at Sterling from the first.

There is still opportunity for a large amount of judicious work in selecting from varying seedling canes, having juices of greater purity; for there are wide differences in this respect, and it will require several years more to develop among them characteristics sufficiently uniform to justify their selection as sugar-producing plants.

Many varieties which had given good results in previous years were planted in a large number of plots in different soils and at various times in order to determine their average value. The stand of cane was almost perfect except where destroyed by drifting sand. The seeds selected at the station have often shown a vitality of 98 per cent at the time of planting. With such seed and due care in sowing, it would seem possible, so far as the experimental work has shown, to have a good stand of cane without either thinning or replanting. Neither was done this year. No fertilizers were used and no suckers nor offshoots removed. With the exception of small plots, which were hoed twice, the cultivation was such as any careful farmer would give his crop. In such hot and dry seasons as this was there seems no doubt that deep and close cultivation after the canes are large injures them. On the other hand, frequent and shallow cultivation, even after the canes are well grown, favor their development on principles of soil physics which are well understood.

The yield of cane per acre was not nearly so large this year as in the season of 1889, but was better than in 1888. In general all the varieties which have been subjected to careful selection showed a larger percentage of available sugar in the juice than any other of the previous years. Another point mentioned is that the character of the juices in the sorghum appears to vary less with the season than does the yield of cane. As an instance of this characteristic, developed by the experiments, we may cite the variety of cane known as 161. In 1889 seventeen analyses of this variety were made, extending from September 4 to October 26. The average percentages given were as follows:

Sucrose	per cent	13.24
Reducing sugar	do	.45
Solids not sugar	do	3.56
Purity	do	76.75

In 1890 twelve analyses of the same variety were made, extending from August 12 to October 21, showing the following mean percentages:

Sucrose	per cent	14.81
Glucose	do	.69
Solids not sugar	do	3.77
Purity	do	76.85

One of the most marked effects of selection, as practiced at Sterling, has been manifested in the earlier maturing of the cane. Some of the different varieties grown during the past year ripened two or three weeks earlier than was the case with the canes from similar but unselected seed.

Judging from the work already done sorghum cane may be developed in any particular direction by continuous selection of the qualities desired. If, for instance, a high sugar content be desirable, by continued selection for high sugar only this property of the cane may be made persistent, and the same is true of low glucose or low non-sugars.

The work of the station during the year comprised 2,500 analyses of average samples of sorghum, in large quantities, taken from the plots, and about 9,000 polarizations of the juices of single selected canes. Twelve thousand selected seed heads from the best varieties were wrapped separately and descriptive tags attached to them for the purpose of continuing the work, not only at the station, but by distributing these seed heads to those interested in such researches. By planting a single seed head and saving all the seed produced therefrom a very large field of cane can be produced from each of these 12,000 heads in 1892. In other words, from these 12,000 selections it would be possible to produce seed enough to plant all the sorghum cane which will be required by all the factories in the United States in 1892. These 12,000 heads have been divided into four classes. Those coming from canes which give a juice of from 80 to 85 per cent. purity, irrespective of sugar content, were placed in the first class; those having a purity of 75 to 80 in the second, and those from 70 to 75 in the third class, and the whole of the remainder in the fourth class.

The seed selections were taken from the following varieties: Early Amber, Undendebule (Nos. 1 and 2), Colman cane (cross of Orange and Amber), Folger's Early, Planters' Friend, Early Orange, Link's Hybrid, No. 160, No. 161, No. 110, No. 112, No. 208, No. 244, No. 289, and No. 350.

The method of making selections may not be devoid of general interest. The method pursued at Sterling was as follows:

Many thousands of canes of the particular kinds selected are run separately through hand mills and the juice from each one put in a tin can. These juices are then roughly tested by a hydrometer, giving readings representing the percentage of total solids contained in them. If this reading is below a certain fixed standard the seed head from this cane is at once rejected, the standard of the juice being kept high enough to insure a rejection of the majority of the canes. If the first reading is satisfactory, the can and the seed head of the cane furnishing the juice therein receive a number. For instance, in the variety No. 112, 765 canes were found which came up to the required standard. These were again assorted by subjecting them to analysis and 185 samples were found to contain over 15 per cent of sugar. These seed heads were then saved and all the others from the variety rejected. From those which were saved another selection was made on the purity of the juice and 121 were found to have purities ranging from 75 to 80. These seed heads were preserved and all the others rejected. Thus of the many thousands of the canes of No. 112 submitted for examination

only 121 seed heads were saved to distribute for planting next spring. With the force at the command of the station it was possible to test 3,000 canes per day. Of course it is not expected that canes showing a high percentage of sugar, say 18 per cent in the juice, will give seed which will on planting give a cane uniformly possessing this high quality. Were this true it would be possible to permanently secure and perpetuate each accidental variation showing a high percentage.

Nevertheless, it is true that seed selected in this way has a tendency to produce a larger number of high-testing canes than before, and thus by continued selection it is possible to develop finally a permanent type showing a decided increase in sugar-producing power.

It must also be taken into consideration that in cases of seed selection the development of the particular varieties of cane would be largely influenced by the environment, that is, by the soil and climate; hence it is illogical to suppose that seed which has been selected in this way and permanently established at Sterling will do equally as well in a soil and climate radically different. It is the object of the Department in this work not to select and establish varieties which will do equally well in all parts of the United States, but to illustrate the methods of establishing varieties in one particular locality, so that the particular variety of cane which is suitable to any one locality may be speedily and scientifically established by selection in other places. In many cases the seeds which have been sent from Sterling, and which continue to give there the best results, have produced canes of much inferior quality in Louisiana and Mississippi, as will be seen by data given from those localities in another place. After 3 years of study of all the varieties of sorghum which could be obtained, amounting in all to nearly 1,000 it does not seem premature to give a list of those which may be called the best. It must be understood, however, that this list is for a soil and climate similar to those in western and central Kansas, and it can not be regarded as being absolutely correct for other and widely different localities.

From the results already obtained Early Amber will be suitable for earliest planting and manufacture, or for very late planting when such is unavoidable. Earlier maturing varieties than Amber have been studied, but none of them can yet be recommended. Folger's Early has improved by selection, and No. 160 and No. 161 ripen soon after Amber and are much superior to it in many respects. Undendebule, Colman, and the well-known Link's Hybrid complete the list. To these may also be added Orange cane and its different varieties, which have proved so successful for manufacture, but which did not deport themselves as well under selection as the varieties mentioned. With the exception of Early Amber, all of these can be recommended in respect of high sugar content, good purity, and persistency of type. Folger's Early has a relatively high glucose content, but the purity is about the same as that of the others. Link's Hybrid is somewhat later in matur-

ing, and has a tall slender stalk, which is liable to be blown down. This latter defect it shares with Nos. 160 and 161.

It is hoped that in the course of a year or two No. 161 can be hastened enough in maturing to take the place of Amber. The belief is entertained that these varieties, excepting Amber, are now superior to those commonly grown for sugar-making, but selection on the lines already explained will probably result in considerable further improvement.

Hitherto the work of selection has been carried on mainly in the direction of high sugar and low glucose percentages, and in this respect its success has been most gratifying. In the future it seems evident that more particular attention must be paid to the purity of the juice, unless indeed Congress should see fit to permit the introduction of the process for making sorghum sugar by removing the gummy matters, which is proposed in another part of this report.

Unless this can be done the greatest hope of the success of the sorghum-sugar industry lies in the direction of securing a juice of high purity and especially one low in the organic matters not sugar. It would be better, therefore, in this respect to base at least one line of selection in this direction, so as to eliminate as far as possible the gummy matters in the cane. The average purity of the juices of the sorghum which have been manufactured so far is not much, if any, above 65, while with sugar cane it is about 80, and with the sugar beet even higher. Of the varieties already selected and established the Colman and No. 161 gave the best results in regard to purity, the number expressing the purity varying between 75 and 80. The importance of having a pure juice will be at once realized when it is known that the amount of sugar which is secured from a given weight of cane does not depend solely upon the content of sugar in the juice, but upon the amount of this sugar which the gummy and other uncrystallizable bodies in the juice will allow to crystallize. This was well illustrated in the work of the Department at Fort Scott, Kansas, in 1886. From sorghum cane the juice of which averaged 7.7 per cent. sucrose and less than 60 purity only 21.5 pounds of commercial sugar per ton of clean cane were made, while from sugar cane sent from Louisiana containing 10.45 per cent. of sugar and having a purity of 73, and worked by precisely the same processes and under the same control, 144 pounds of sugar were made per ton.

It appears true of sorghum juices that the nonsugars, consisting of the glucose and solids not sugar, taken together, may be in all about 4 to 5½ per cent. of the juice. It has been shown by the 3 years' selection at Sterling that the glucose percentage can be reduced to a point at which it may be practically neglected, viz., to about one-half of 1 per cent. The selection for the purpose of reducing the organic bodies not sugar has not been carried far enough to determine whether or not similar success can be expected. At the present, however, it

appears that there is a kind of reciprocity existing between the glucose and solids not sugar, so that as one is increased the other is diminished, the sum thus remaining about a constant quantity. As a rule the varieties which have a low glucose content have a high content of organic solids not sugar, and the reverse is true. If this should be the correct view, it would make the problem of selection a more difficult one, and the wiser plan would be to pursue it in the direction of reducing the organic solids not sugar and increasing the glucose, provided the manufacture of sugar is to be carried on as it now is; while if the alcohol process for the separation of the organic solids in sugar should come into use, then the wiser plan would be to pursue the selection with reference to diminishing the glucose to the least possible degree. The separation of the organic bodies not sugar by alcohol would leave a juice of remarkable purity and capable of yielding the maximum percentage of crystallizable sugar. It is highly probable, however, that all the nonsugars may finally be much reduced in amount by continued selection.

The results of the station work show that Early Amber, Folger's Early, and the various varieties of Orange have comparatively high glucose, and, as a rule, low percentages of solids not sugar. This accounts for the fact that in practice the Orange, although having a high percentage of glucose, has given uniformly good results. On the other hand, Undendebule, Colman cane, No. 161, Sorghum Bicolor, and Link's Hybrid show generally low percentages of glucose and high percentages of organic solids not sugar.

In general, therefore, it may be said that the lines of selection as indicated above will depend upon the method of manufacture to be pursued. If the method remains as it is, then without any question the direction of the lines of selection should be toward securing a juice of greater purity, even should the sucrose content itself suffer. It is far better for the manufacturer to have a sorghum juice containing 12 to 13 per cent. of sugar in the juice and a purity of 85 than to have one from 16 to 18 per cent. sugar in the juice with a purity of 65.

I have already said that the cause of a poor yield of sugar in sorghum of high polarization is due to the presence of some form of carbohydrate or other organic body exercising a higher melassigenic power than invert sugar or any form of levulose or dextrose, and the results of the research carried on in the laboratory during the past 18 months have disclosed to us the exact nature of this body, and also revealed the method of separating it as indicated in another portion of this report.

Mr. John Dymond and Dr. W. C. Stubbs estimate that a fair average analysis of Louisiana sugar-cane juice, would be as follows:

Solids	per cent..	15.00
Sucrose	do....	12.00
Glucose	do....	1.50
Purity		80.00

It would be of interest to compare these numbers with the averages of the sorghum worked in the four sugar houses at Attica, Medicine Lodge, Conway Springs, and Meade during the season of 1889, and also to compare it with the general average of the Colman cane during the present season:

	Louisiana sugar cane.	Factory sorghum.	Colman cane.
Total solids.....per cent..	15.00	17.46	19.48
Sucrose .....do . .	12.00	11.08	14.88
Glucose .....do....	1.50	2.37	.84
Solids not sugar.....do....	1.50	4.01	3.76
Purity.....do...	80.00	63.45	76.37

It is easy to see from the above figures why the sugar cane yields a much larger percentage of sugar than sorghum. At the same time a glance will show that the removal of 3.76 per cent of the solids not sugar in the Colman cane would at once place it in the first rank of sugar-producing plants as compared with the others given above.

In the selections made at Sterling particular attention has always been given to the persistence of the sugar content. A variety which retains for a long time a high percentage of sugar in the field is of course preferable to one which rapidly loses its sugar content after having become fully ripe. The former allows more latitude for harvesting the crop, and also permits those canes which from various causes mature later than others time to attain their maximum content before they are harvested, so that when they are finally worked they are in good condition. There are considerable differences in this respect among the different varieties. Some, as for instance the White African, and even the Early Amber, began to retrograde soon after maturity; others are much more constant. Of all the varieties tried No. 161 has proved the most durable. One plot of this variety has held up its sugar content for 70 days, the longest period ever known, and in spite of exceptionally adverse climatic conditions. Colman cane, which ripens somewhat later, is second in this respect. It seems probable that both these varieties will continue to disclose this good quality and will keep their sugar until second growth is far advanced. With this latter point is closely connected another, viz., the preservation of sugar content in the canes after they have been harvested. It is probable that the two are correlated and that the kind which keeps better in the field than others will also hold up its sugar content better after harvesting. It is very difficult for factories to arrange cutting, hauling, and manufacture to insure the selection of all the canes suitable after harvesting. The losses, therefore, in this respect are very great at every factory and the glucose ratio differs widely between field and diffusion battery.

If varieties of cane could be produced which might be cut and left for a week or so before working, without serious damage, it would be a

great step forward in the sorghum-sugar industry. Work in selection on this line was planned, but owing to the press of other work and early frost it was abandoned during the present season.

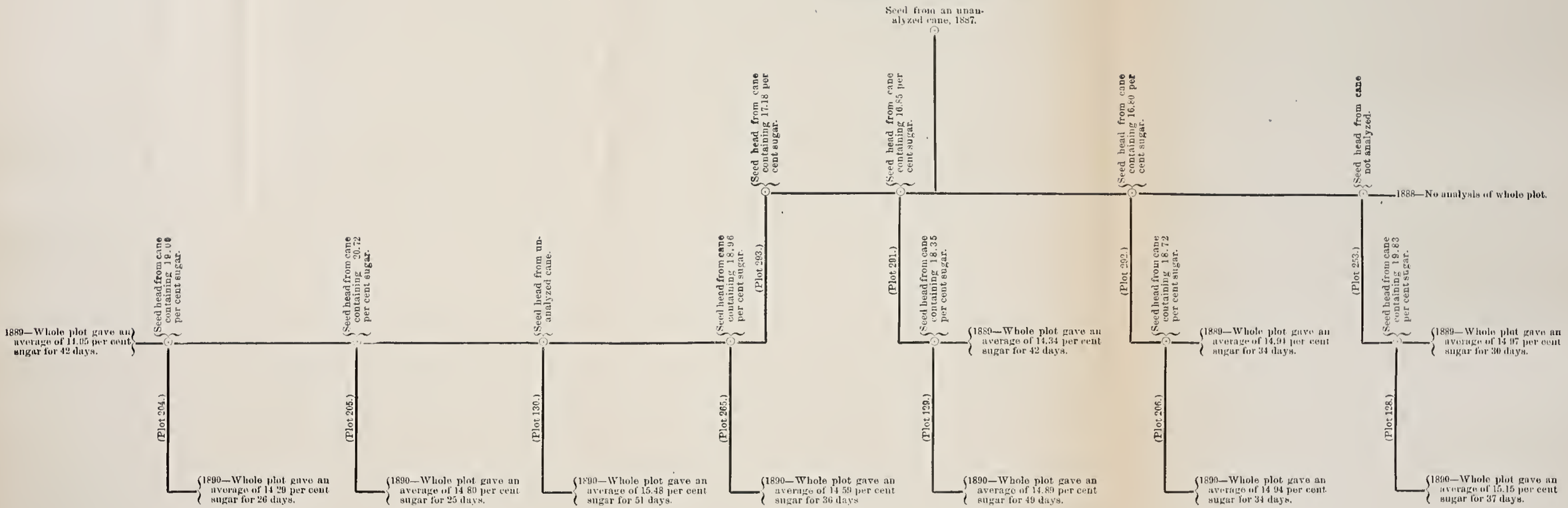
In general it appears that all the varieties of sorghum which have been tested may be divided into several classes: First, those varieties which have only a fair percentage of sugar and low glucose, as, for instance, Sorghum Bicolor, which for 3 years has had an average in its working period of 12.50 per cent of sugar and less than 1 per cent of glucose; second, varieties which have a good percentage of sugar and comparatively high glucose, with a low percentage of solids not sugar; this variety is illustrated by the Early Orange, which for 3 years has shown during its working period about 14 per cent of sugar and 2 per cent. of glucose; third, varieties which have high sugar content and low glucose. This variety is illustrated by Undendebule No. 1, which has shown for 3 years during its working period 15.50 per cent of sucrose and 0.70 of glucose. No. 161 has also shown good results in this direction, having for 2 years an average of 15 per cent sugar and about 0.50 per cent glucose. Fourth, varieties with a moderate percentage of both glucose and sucrose; this class is illustrated by No. 250, an African variety, which has given for 2 years an average of 12.50 per cent sucrose and 1.25 per cent glucose.

STUDIES OF THE DIFFERENT VARIETIES OF SORGHUM.

COLMAN CANE.

The history of this variety is interesting as showing the development of fixed varieties from crosses. A seed head cut in 1887 from a cane resulting from a cross of Kansas Orange and Early Amber was planted in 1888 in a plot by itself. The crop was rather uneven, showing reversions to both parental forms in greater or less degree. From this plot were selected three seed heads by analysis of the canes, and a fourth from physical characteristics. These were last year planted in separate plots and resulted in the production of four "strains" from the original cross. These plots were fairly uniform within themselves, though varying somewhat from one another. All, however, showed good traits, and from one, descended from the second best seed selection made in 1888, was obtained a cane showing 20.72 per cent of sugar in the juice, the highest sorghum analysis ever recorded. This year seven plots were planted with selected seed heads. They were all remarkably uniform within themselves, more so, probably, than those of any other variety, though each varied still from the others, this difference being of course most marked in descendants of different strains. A diagram aranged in the form of a genealogical table has been made to show the lines of descent and render clearer the system of breeding.

PEDIGREE OF COLMAN CANE.


Seed from an unanalyzed cane, 1887.
1889—Whole plot gave an average of 14.05 per cent sugar for 42 days.
(Seed head from cane containing 19.06 per cent sugar.
(Plot 204.)
1890—Whole plot gave an average of 14 29 per cent sugar for 26 days.
(Seed head from cane containing 20.72 per cent sugar.
(Plot 205.)
1890—Whole plot gave an average of 14 80 per cent sugar for 25 days.
(Seed head from unanalyzed cane.
(Plot 130.)
1890—Whole plot gave an average of 15.48 per cent sugar for 51 days.
(Seed head from cane containing 18.96 per cent sugar.
(Plot 265.)
1890—Whole plot gave an average of 14 59 per cent sugar for 36 days
(Plot 293.)
(Seed head from cane containing 17.18 per cent sugar.
(Plot 201.)
(Seed head from cane containing 18.35 per cent sugar.
1889—Whole plot gave an average of 14.34 per cent sugar for 42 days.
(Plot 129.)
1890—Whole plot gave an average of 14.89 per cent sugar for 49 days.
(Seed head from cane containing 16.85 per cent sugar.
(Plot 292.)
(Seed head from cane containing 18.72 per cent sugar.
1889—Whole plot gave an average of 14.94 per cent sugar for 34 days.
(Plot 206.)
1890—Whole plot gave an average of 14 94 per cent sugar for 34 days.
(Seed head from cane containing 16.80 per cent sugar.
(Plot 253.)
(Seed head from cane containing 19.83 per cent sugar.
1889—Whole plot gave an average of 14 97 per cent sugar for 30 days.
(Plot 128.)
1890—Whole plot gave an average of 15.15 per cent sugar for 37 days.
(Seed head from cane not analyzed.
1888—No analysis of whole plot.

Face page 63.

GENEALOGICAL TABLE.

The variety whose pedigree is given in the geneological table was named in honor of ex-Secretary Colman, under whose administration the culture station was established. It was known formerly as "Cross of Amber and Orange."

The canes are short and stocky, somewhat after the Orange type. The seed head is small, but the seeds are rather large. This is a valuable quality, for sprouts from large seeds get a better start than those from small. In period of maturity the variety is medium late, coming in just after Folger's Early. It has a high per cent of sugar, a low per cent of glucose, and is very uniform in analysis. The nonsugars are rather high. In other localities this cane has done very well. At Calumet, in Louisiana, Mr. W. J. Thompson reports it as being good, and at the State Experiment Station, at Manhattan, Kansas, it has given good results. At Attica, Kansas, this year it was regarded as the richest cane grown.

EXPLANATION OF TABLES.

The following tables contain the averages of the analyses of the different varieties of pedigreed sorghum canes at Sterling.

The first column of the tables, headed "parent plot," refers to the original number of the plot, cultivated in 1888 or 1889, from which the parent seed head was obtained.

The column marked "plot" refers to the number of the plot of the season of 1890. These numbers are preserved in order that the pedigree of any given plot may be traced in the record books of the Department.

The "dates" refer to the times within which the analyses were made.

The column marked "days" gives the length of the season during which the examinations were continued and shows approximately the number of days in which the plot would have been fit for sugar-making purposes.

Under the column "No. of analyses" the total number of separate analyses is found from which the average data following are obtained.

The column entitled "other solids" includes all the bodies present in the juice with the exception of the sucrose or cane sugar and the glucose or reducing sugar. It, therefore, includes all the mineral matters which are usually estimated as ash, and carbohydrates, nonsugars such as starch, etc., and the gums and mucilages. In the columns marked "coefficient" are found the results of dividing the percentage of each constituent in the juice by the percentage of total solids therein.

The column headed "sucrose coefficient" represents the same number as is indicated usually by the term "coefficient." The percentage of sucrose present in the juices which can be obtained as crystallizable sugar will increase as the number under the head of "sucrose coefficient" increases and the numbers under the other two heads decrease.

Average of analyses of Colman cane.

1889.

Parent plot, 1888–'89.	Plot, 1890.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
	253	Sept. 16 Oct. 24	38	7	18.73	14.97	1.00	2.76	79.92	5.34	14.74
	291	Sept. 18 Oct. 24	41	6	18.51	14.34	1.23	2.94	77.47	6.65	15.88
	292	Sept. 13 Oct. 24	41	3	19.67	14.94	1.07	3.66	75.96	5.44	18.60
	293	Sept. 13 Oct. 24	41	6	18.27	14.05	1.30	2.92	76.90	7.12	15 98
Means	.....	.....	.....	.....	18.80	14.58	1.15	3.07	77.55	6.12	16.33

1890.

253....	128	Sept. 19 Oct. 15	36	7	19.84	15.15	.77	3.92	76.35	3.90	19.75
291....	129	Aug. 27 Oct. 15	49	9	19.64	14.89	.70	4.05	75.81	3.57	20.62
.....	130	Aug. 25 Oct. 15	51	9	19.79	15.48	.51	3.80	78.22	2.58	19.20
293....	204	Sept. 9 Oct. 4	25	5	19.15	14.29	1.17	3.69	74.62	6.11	19.27
293....	205	Sept. 18 Oct. 7	19	4	19.73	14.80	.99	3.94	75.01	5.01	19.98
292....	206	Sept. 27 Oct. 7	41	6	19.12	15.00	.75	3.37	78.45	3.92	17.13
293....	265	Sept. 2 Oct. 7	36	5	19.06	14.59	1.02	3.45	76.55	5.35	18.10
Means	.....	.....	.....	.....	19.48	14.88	.84	3.76	76.38	4.31	19.31

NO. 160 AND NO. 161.

This new variety originated in 1888 from two selections of crossed canes of Early Amber and Link's Hybrid. The canes of both strains resemble Link's Hybrid, being tall and slender and like it exposed to the danger of being blown over. The seed top of 160 resembles that of Amber, that of 161 is Link's Hybrid in type and smaller than that of any other variety except Undendebule No. 1. No. 160 and No. 161 are practically the same in quality, both having high sugar and low glucose and both being very constant in sugar content. Both ripen early and, as before mentioned, it seems quite possible that by means of continuous selection of early ripening canes the variety can be hastened enough in period of maturity to take the place of Amber.

Averages of analyses of varieties 160 *and* 161.

VARIETY 160—1889.

Parent plot, 1889.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
.	160	Sept. 13 Oct. 22	39	8	17.86	13.84	.61	3.41	77.49	3.42	19.09

VARIETY 160—1890.

160	28	Aug. 25 Oct. 22	58	10	20.06	15.00	.58	4.48	74.77	2.89	22.34
	29	Aug. 25 Oct. 22	58	10	18.93	14.30	.84	3.79	75.54	4.44	20.02
	269	Sept. 2 Oct. 15	43	6	17.76	12.73	.43	4.60	71.67	2.42	25 91
Mean .	.....	.....	.....	26	18.92	14.01	.62	4.29	74.05	3.27	22.68

VARIETY 161—1889.

	161	Sept. 4 Oct. 26	43	18	17.12	13.24	.45	3.43	77.33	2.67	20.03

VARIETY 161—1890.

161	36	Aug. 12 Oct. 21	70	12	19.27	14.81	.69	3.77	76.86	3.58	19.56
	37	Aug. 23 Oct. 21	59	11	19.04	14.56	.94	3.54	76.47	4.94	18.59
	271	Sept. 2 Oct. 8	36	7	17.67	12.98	.48	4.21	73.48	2.75	23.77
	272	Aug. 25 Oct. 8	44	8	17.96	13.76	.57	3.63	76.62	3.17	20.21
Mean .	.....	.....	.....	38	18.48	14.03	.67	3.78	75.92	3.62	20.46

FOLGER'S EARLY.

This new variety originated in selections made from Early Amber in Iowa by Mr. A. S. Folger.

The seeds selected by him were planted here in 1888 and produced fine canes, which, however, were quite variable in sugar content and other respects. A selection of seed from a single cane planted in plot 205, in 1889, gave canes more uniform in type, and with a much improved sugar per cent. Two plots were planted with unselected seed for comparison. Selections made from plot 205 and planted this year gave a very uniform progeny with a high per cent of sugar and a relatively high glucose, with the incidental low non-sugar. A comparison of the analyses of Folger's Early for the 3 years shows a clearly marked

progressive improvement in quality, and is illustrative of the possibilities of seed selection.

Averages of analyses of Folger's Early.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
(*)	248	Sept. 10 – Oct. 15	35	10	15.62	10.66	1.88	3.08	68.24	12.04	19.72

1889.

248	205	Sept. 5 – Oct. 1	26	7	18.39	14.08	2.03	2.28	76.56	11.04	12.40
(*)	247	Sept. 2 – Sept. 30	28	7	15.18	10.84	1.58	2.76	71.41	10.41	18.18
	248	Sept. 16 – Oct. 25	39	9	15.16	10.84	1.61	2.71	71.50	10.63	17.87

1890.

205	110	Aug. 25 – Oct. 15	51	11	18.57	14.28	1.19	3.10	76.89	6.42	16.69
	111	Aug. 25 – Oct. 15	51	11	19.49	14.59	2.03	2.87	74.87	10.43	14.70
	112	Aug. 27 – Oct. 15	49	10	18.48	13.49	2.05	2.94	72.99	11.10	15.91
Mean	.....	.....	.....	32	18.85	14.12	1.76	2.97	74.69	9.31	16.00

* Unselected.

UNDENDEBULE.

This variety came originally from Africa. It was grown by the Department in Washington in 1882 and gave then, as an average of 15 analyses, 13.50 per cent of sugar and less than 1 per cent of glucose. It has been grown here for 3 years and has displayed the same characteristics of high sugar and low glucose, which have been further accentuated by seed selection. In the seeds of this variety sent this station in 1888 by Dr. Collier, director of the New York State Experiment Station, were mixed the seeds of two distinct varieties, which were, however, grown together both that year and last. This year they have been separated and distinguished as Undendebule Nos. 1 and 2. No. 1 is short and stocky, with smaller seed heads than any other variety grown here. The present year it has been much better than No. 2. No. 2 is larger and shorter and has a much heavier seed top than No. 1. Both are medium late, coming in at about the same time as Early Orange. Judged solely by the sucrose and glucose per cents, No. 1 is one of the best of the varieties.

Averages of analyses of Undendebule.

NOS. 1 AND 2—1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
(*)	39	Sept. 18 Oct. 15	27	4	17.17	12.31	.73	4.13	71.69	4.25	24.06

NOS. 1 AND 2—1889.

39.....	31	Oct. 1 Oct. 10	9	2	21.15	16.28	.57	4.30	76.79	2.69	20.52
39.....	254	Sept. 12 Oct. 25	43	10	17.95	13.69	.82	3.44	76.06	4.55	19.39
39.....	397	Oct. 4 Oct. 25	21	5	18.95	14.78	.68	3.49	78.00	3.59	18.41

NO. 1—1890.

254	114	Sept. 12 Oct. 15	33	6	21.10	15.72	.63	4.75	74.50	2.98	22.52
	116	Sept. 13 Oct. 18	35	6	21.81	16.42	.46	4.93	75.29	2.11	22.60
	117	Sept. 12 Oct. 15	33	6	21.07	15.72	.68	4.67	74.61	3.23	22.16
Average.....					21.33	15.95	.59	4.79	74.77	2.77	22.46

NO 2.—1890.

31.....	113	Sept. 2 Oct. 15	43	7	18.95	13.51	1.33	4.11	71.29	7.02	21.69
254....	115	Sept. 12 Oct. 4	22	4	18.84	13.78	.88	4.18	73.14	4.67	22.19
Average					18.89	13.64	1.10	4.15	71.78	6.16	22.06

*Unselected.

LINK'S HYBRID.

This variety has always been considered one of the best for sugar making since the first distribution of its seeds by Commissioner Le Duc. It is very late in maturing, the last analyses taken before frost being generally the best. It thus affords but little time to work the canes when at their best, and the occasional complaints heard of the sugar-yielding qualities of the variety are mainly attributable to too early harvesting. The stalks are tall and slender, and, having a heavy seed head, are liable to be broken down by the wind. In the 3 years' work here more cane has been lost from Link's Hybrid in this way than from any other, perhaps than from all other varieties. Attempts have been made to remedy this defect by crossing the variety with others which are shorter and better rooted, such as the Oranges, and with very fair suc-

cess. It has also been done by simply selecting seed from canes of the pure variety possessing the desired quality, of which plot 65 is an example. More work has been done here upon Link's Hybrid than upon any other variety. This year 57 plots were planted with selections from it. Some of these plots arrived at maturity a month before those from unselected seed, the canes having all the desirable qualities of Link's Hybrid and a much longer working period. The quality of the juice is very good, though averaging better last year than this, as the frost caught it in the midst of the sugar-forming period. The sugar per cent is generally high and the glucose low. Last year the non-sugar was lower than in any other variety with correspondingly low glucose, but this year in consequence possibly of the frost it is much higher, and follows the general rule.

The Link's Hybrid, improved as it may be, should be a good variety for sugar making in this latitude.

Averages of analyses of Link's Hybrids.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
	0	Sept. 21 – Oct. 24	33	25	18.06	13.02	1.06	3.98	72.09	5.87	22.04

1889.

0	116	Sept. 17 – Oct. 22	35	7	18.46	15.18	.65	2.63	82.23	3.53	14.24
	149	Sept. 30 – Oct. 22	22	4	18.38	14.77	.57	3.04	80.35	3.11	16.54
	150	Sept. 20 – Oct. 22	32	6	18.30	14.75	.55	3.00	80.60	3.01	16.39
	153	Oct. 2 – Oct. 22	20	6	19.94	15.49	.55	3.90	77.68	2.76	19.56
	154	Sept. 25 – Oct. 22	27	5	19.08	15.17	.57	3.34	79.51	3.00	17.51
	162	Sept. 17 – Oct. 22	35	8	18.93	14.91	.66	3.36	78.76	3.48	17.75
	163	Sept. 25 – Oct. 22	27	5	19.29	15.21	.72	3.36	78.85	3.78	17.36
	164	Sept. 25 – Oct. 22	27	6	19.83	15.56	.83	3.44	78.47	4.18	17.35
	165	Sept. 20 – Oct. 22	32	5	19.53	15.09	.88	3.56	77.26	4.51	18.23
	166	Sept. 25 – Oct. 22	27	5	19.96	15.36	.76	3.84	76.95	3.81	19.23
	244	Oct. 3 – Oct. 25	22	5	19.39	15.32	.64	3.43	79.01	3.30	17.69
Mean					19.19	15.16	.65	3.38	79.00	3.39	17.61

Averages of analyses of Link's Hybrids—Continued.

1890.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugar.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
(*)	30	Sept. 1 Oct. 22	51	9	18.23	13.24	1.05	3.94	72.63	5.75	21.62
164	31	Sept. 1 Oct. 22	51	9	18.88	13.91	.98	3.99	73.67	5.16	21.17
	33	Sept. 18 Sept. 29	11	2	19.71	13.50	1.56	4.65	68.49	7.92	23.59
163	35	Sept. 8 Oct. 21	43	9	19.21	13.78	1.17	4.26	71.74	6.08	22.17
	38	Sept. 8 Sept. 25	17	4	18.21	13.61	1.57	3.03	74.74	8.62	16.64
	42	Sept. 8 Oct. 10	32	7	17.81	12.63	1.27	3.91	70.91	7.13	21.96
158	43	Sept. 8 Sept. 18	40	4	18.64	13.75	.70	4.19	73.76	3.76	22.48
	44	Sept. 8 Oct. 10	32	5	17.55	12.47	1.16	3.92	71.06	6.61	22.33
150	47	Sept. 8 Sept. 30	22	6	17.73	12.61	1.44	3.68	71.14	8.11	20.75
	48	Sept. 8 Sept. 30	22	6	17.36	11.70	1.46	4.20	67.39	8.41	24.20
	49	Aug. 26 Sept. 30	35	6	18.30	12.96	1.43	3.91	70.82	7.81	21.37
162	50	Aug. 26 Oct. 10	45	7	17.18	12.30	1.02	3.86	71.59	5.94	22.47
150	53	Sept. 8 Oct. 21	43	6	18.50	13.33	1.01	4.16	72.08	5.42	22.50
153	54	Sept. 1 Oct. 21	50	9	18.62	13.48	.83	4.31	72.40	4.46	23.14
166	55	Sept. 8 Oct. 13	35	7	19.27	13.49	1.07	4.71	70.00	5.55	24.45
	56	Sept. 1 Oct. 21	50	10	18.91	13.96	1.11	3.84	73.82	5.87	20.31
	57	Sept. 1 Oct. 13	42	8	19.49	14.22	.89	4.38	72 96	4.57	22.47
165	58	Sept. 1 Oct. 21	50	8	19.88	14.20	1.34	4.34	71.43	6.74	21.83
116	61	Sept. 8 Oct. 13	42	8	18.75	13.49	1.20	4.06	71.95	6.40	21.65
	65	Sept. 2 Oct. 22	50	9	19.26	13.90	1.09	4.27	72.18	5.65	22.17
	66	Sept. 2 Oct. 22	50	8	19.82	14.34	.84	4.64	72.35	4.24	23.41
Mean					18.63	13.37	1.15	4.11	71.77	6.17	22.06

* Unselected.

WHITE INDIA

Is also called White Mammoth and Enyama. White India canes are large, erect, and strongly rooted and it transmits these characteristics to its crosses. Were it somewhat earlier in maturing this would be a fair variety. The seeds are white. The sugar content of the juice is only moderate, and the glucose and nonsugar per cents are both high.

Averages of analyses of White India.

1888.

Parent plot, 1888–'89	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent	*Pr. cent.*	*Pr. cent.*	*Pr. cent*			
	68	Sept. 12 – Oct. 9	27	4	17.50	11.43	2.31	3.76	65.32	13.20	21.48
	69	Sept. 19 – Oct. 9	20	4	16.44	11.29	1.27	3.88	68.67	7.73	23.60
	70	Sept. 19 – Oct. 9	20	4	17.41	11.92	1.67	3.82	68.47	9.59	21.94
Mean.	.....	.....	.....	.....	17.12	11.55	1.75	3.82	67.49	10.19	22.32

1889.

	28	Oct. 8 – Oct. 25	17	4	14.76	8.69	1.48	4.59	58.83	10.06	31.11
	401	Oct. 25 – Oct. 26	2	2	14.60	9.57	2.19	2.84	65.55	15.00	19.45
Mean.	.....	.....	.....	.....	14.68	9.13	1.82	3.72	62.19	12.53	25.28

1890.

	237	Sep. 12	1	1	17.14	12.20	1.50	3.44	71.18	8.75	20.07

HONDURAS.

This variety was grown here in all three years, but was cut off by the frost this season. Honduras is a very late variety, too late for sugar-making in this latitude as it requires 5.5 months to mature. Considerable improvement in this regard has been effected by seed selection. The canes are very large and the variety gives a much higher tonnage than any other. The per cent of sugar in the juice is low and the glucose relatively high, but the purity is often very good. This is probably the only juice low in solids in which the purity ever gets over 75.

Averages of analyses of Honduras.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
(*)	37	Oct. 6 – Oct. 15	9	2	15.64	9.44	3.24	2.96	60.35	18.94	20.71

Averages of analyses of Honduras—Continued.

1889.

Parent plot. 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
	3	Oct. 8 to Oct. 25	17	3	16.22	12.69	1.19	2.34	78.24	7.34	14.42
	103	Oct. 8 to Oct. 25	17	4	16.25	12.75	1.36	2.14	78.46	8.37	13.17
	105	Oct. 8 to Oct. 26	18	3	16.80	11.88	1.85	3.07	70.71	11.02	18.27
	106	Oct. 8 to Oct. 25	17	4	15.87	10.88	1.89	3.10	68.56	11.91	19.53
	115	Sept. 20 to Oct. 12	22	4	14.42	8.82	3.07	2.53	61.15	21.29	17.56
	119	Sept. 14 to Oct. 8	24	7	16.42	11.97	1.44	3.01	72.90	8.77	18.33
	120	Sept. 14 to Oct. 8	24	6	16.45	11.71	2.67	2.07	71.19	16.23	12.58
	236	Oct. 4 to Oct. 25	18	3	15.77	12.00	1.88	1.89	76.10	11.92	11.98
Mean					16.03	11.59	1.92	2.52	72.30	11.98	15.72

* Unselected.

UBEHLANA.

This variety gives fine canes, but is somewhat late in ripening. Two subvarieties exist, distinguished only by color of seed.

Averages of analyses of Ubehlana.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
(*)	61	Oct. 6 to Oct. 15	9	2	18.85	13.10	2.33	3.42	69.50	12.36	18.14

1889.

C1	34	Oct. 8 to Oct. 25	17	3	18.46	13.36	1.84	3.26	72.35	10.00	17.65
	226	Oct. 3 to Oct. 25	22	3	16.93	11.52	2.87	2.54	68.05	16.95	15.00
	326	Oct. 5 to Oct. 10	5	2	15.44	11.31	1.61	2.52	73.25	10.43	16.32
	378	Oct. 10 to Oct. 26	16	2	18.10	11.91	2.69	3.50	65.80	14.96	19.34
Mean					17.24	12.03	2.25	2.96	69.78	13.05	17.17

1890.

(*)	188	Sept. 12 to Oct. 7	25	4	18.65	11.57	2.89	4.19	62.04	15.50	22.46
	192	Sept. 13 to Sept. 27	14	3	18.72	13.45	2.16	3.11	71.84	11.54	16.62
Mean					18.68	12.51	2.52	3.65	66.94	13.02	19.54

*Unselected.

WHITE AFRICAN.

White African, though a favorite variety in New Jersey and Delaware, has proved an inferior one here in its three years' trial. It spoils soon after becoming ripe.

Averages of analyses of White African.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*			
(*)	77	Sept. 11 Sept. 19	8	2	12.97	5.73	2.04	5.20	44.18	15.73	40.09

* Unselected.

1889.

77	237	Sept. 6 Sept. 26	20	7	17.21	12.21	1.41	3.59	70.95	8.20	20.85

1890.

237	186	Sept. 2 Sept. 12	10	2	19.02	13.32	1.94	3.76	70.03	10.20	19.97

WHITING'S EARLY.

This variety ripens earlier than Amber, but it has little else to recommend it. The canes are very small and are variable in quality. The sugar content is low and the glucose high.

Average of analyses of Whiting's Early.

1888.

Parent plot, 1888–89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*			
(*)	233	Aug. 25 Sept. 6	12	3	16.00	10.13	2.12	3.75	63.31	13.25	23.44

* Unselected.

1889.

233	399	Aug. 30 Sept. 21	22	7	15.41	10.26	1.77	3.38	66.58	11.48	21.94

1890.

399	176	July 20 Aug. 21	32	6	13.41	7.87	1.75	3.73	58.70	13.04	28.26

BLACK AFRICAN.

Black African canes are tall and slender, and have a good sugar and medium glucose content. They ripen at about the same time as those of Orange. The variety is highly prized at the sugar factories in Topeka and Medicine Lodge.

Averages of analyses of Black African.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
(*)	109	Sept. 11 to Oct. 25	44	11	*Pr.cent.* 18.66	*Pr.cent.* 14.24	*Pr.cent.* .81	*Pr.cent.* 3.61	76.32	4.34	19.34

* Unselected.

1890.

109	104	Aug. 25 to Oct. 15	51	11	19.13	13.05	1.31	4.77	68.2$_3$	6.84	24.94
	105	Sept. 15 to Oct. 25	42	6	18.65	13.66	1.34	3.65	73.24	7.19	19.57
	Mean				18.89	13.56	1.32	4.21	70.73	7.02	22.25

WHITE ENFIELD.

The seed of the White Enfield was obtained from Texas. The canes are large and handsome, and late in maturing. They have a large seed top and white seed. Sugar, glucose, and purity are low.

Averages of analyses of White Enfield.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
(*)	230	Oct. 7 to Oct. 25	18	4	*Pr.cent.* 16.58	*Pr. cent.* 11.80	*Pr. cent.* .82	*Pr.cent.* 3.96	71.17	4.94	23.89

1890.

230	236	Sept. 6 to Sept. 23	17	2	14.60	9.40	1.16	4.04	64.38	7.95	27.67

*Unselected.

CHINESE.

Chinese was one of the first varieties of sorghum to be introduced into this country. The sugar content is only fair, the glucose and non-sugar are high.

Averages of analyses of Chinese.

1888.

Parent plot. 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity of sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
(*)	68	Sept. 7 – Oct. 15	38	6	16.31	9.97	2.17	4.17	61.13	13.31	25.56
	215	Sept. 17 – Oct. 8	21	3	15.82	9.34	2.17	4.31	59.04	13.72	27.24
	216	Sept. 18 – Oct. 15	27	4	15.85	9.31	2.71	3.83	58.74	17.16	24.10
	232	Sept. 17 – Oct. 15	28	5	17.05	10.98	1.99	4.08	64.40	11.67	23.93
Mean					16.26	9.90	2.26	4.10	60.88	13.90	25.22

1889.

	9	Oct. 1 – Oct. 8	7	3	18.54	12.53	1.37	4.64	67.58	7.38	25.04
	39	Oct. 1 – Oct. 25	24	5	17.53	13.05	1.16	3.32	74.44	6.62	18.94
	58	Sept. 14 – Oct. 8	24	5	16.02	11.61	1.68	2.73	72.47	10.49	17.04
	76	Sept. 21 – Oct. 8	17	2	15.41	11.08	1.20	3.13	71.90	7.79	20.31
	79	Sept. 1 – Oct. 2	11	4	16.44	12.39	1.62	2.43	75.37	9.85	14.78
	81	Sept. 14 – Oct. 12	28	4	16.79	12.19	1.72	2.88	72.61	10.24	17.15
	199	Sept. 5 – Oct. 1	26	5	16.58	11.08	2.52	2.98	66.82	15.20	17.98
	223	Sept. 14 – Oct. 25	41	5	15.63	10.60	2.43	2.60	67.82	15.55	16.63
	229	Sept. 2 – Oct. 7	35	7	15.69	10.23	2.02	3.44	65.22	12.86	21.92
	260	Sept. 19 – Oct. 3	14	5	16.05	11.39	2.32	2.34	70.97	14.45	14.58
Mean					16.47	11.61	1.82	3.04	70.50	11.05	18.45

1890.

(*)	15	Sept. 6 – Sept. 12	6	3	18.25	12.57	1.68	4.00	68.88	9.20	21.92

* Unselected.

SORGHUM BICOLOR.

This kind is sometimes called "Red Sorghum." The canes are rather small and each has three seed heads. In the 3 years of trial here the variety has uniformly given very low glucose, moderate sugar, and fair purity.

Averages of analyses of Sorghum Bicolor.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
	15	Sept. 18 to Sept. 26	8	2	18.00	12.13	.76	5.11	67.39	4.22	28.39
	52	Sept. 18 to Oct. 20	32	6	16.90	11.10	.79	5.01	65.68	4.67	29.65
Mean.					17.45	11.61	.77	5.07	66.54	4.44	29.02

1889.

	51	Oct. 4 to Oct. 25	21	4	17.87	12.89	.60	4.38	72.12	3.36	24.52
	70	Oct. 4 to Oct. 25	21	4	18.51	13.50	.57	4.44	72.92	3.08	24.00
	74	Oct. 1 to Oct. 8	7	2	17.32	13.27	.89	3.16	76.62	5.14	18.24
	231	Sept. 9 to Oct. 11	32	7	16.94	12.07	.85	4.02	71.25	5.02	23.73
	258	Sept. 9 to Oct. 11	32	8	16.90	11.62	1.09	4.19	68.76	6.45	24.79
	259	Sept. 9 to Oct. 24	45	9	17.22	12.11	1.07	4.04	70.32	6.22	23.46
	261	Sept. 16 to Oct. 3	17	3	16.47	11.57	1.26	3.64	70.25	7.65	22.10
Mean.					17.31	12.43	.90	3.98	71.80	5.20	23.00

1890.

259	118	Sept. 9 to Oct. 15	36	5	18.88	13.30	.76	4.82	70.44	4.03	25.53
70	119	Sept. 2 to Oct. 15	43	7	18.27	12.61	.86	4.80	69.00	4.75	26.25
	120	Sept. 9 to Oct. 15	36	6	18.90	13.30	.79	4.81	70.37	4.18	25.45
261	121	Sept. 13 to Oct. 15	32	5	18.37	12.40	.73	5.24	67.50	3.98	28.52
	122	Sept. 9 to Oct. 8	29	5	18.23	12.85	1.37	4.01	70.49	7.51	22.00
51	123	Sept. 9 to Oct. 8	29	5	18.00	12.31	1.29	4.40	68.39	7.17	24.44
Mean.					18.44	12.80	.96	4.68	69.41	5.21	25.38

PRICE'S NEW HYBRID.

This variety is not very early, has low sugar and purity and high glucose.

Averages of analyses of Price's New Hybrid.

1888.

Parent plot, 1888-'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
(*)	101	Sept. 3 Sept. 6	3	2	16.47	9.98	2.83	3.66	60.60	17.18	22.22

1889.

101 ...	251	Sept. 9 Sept. 23	14	5	14.88	9.47	2.31	3.10	63.64	15.51	20.83

* Unselected.

JYANGENTOMBI.

Chinese type of canes. Sugar content good, glucose and purity fair in 1889. This year's stand was nearly destroyed by blowing sand.

Averages of analyses of Jyangentombi.

1889.

Parent plot, 1888-'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent*	*Pr. cent.*	*Pr.cent.*			
(*)	35	Oct. 1 Oct. 25	24	5	19.00	14.31	1.02	3.67	75.32	5.36	19.32

1890.

35	189	Sept. 13 Sept. 16	3	2	18.05	11.82	2.09	4.14	65.48	11.58	22.94

* Unselected.

SORGHUM BLEU.

Tall and erect canes. The variety is not desirable.

Averages of analyses of Sorghum Bleu

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
	101	Oct. 4 – Oct. 25	21	3	*Pr. cent.* 17.48	*Pr. cent.* 12.52	*Pr. cent.* 1.14	*Pr. cent.* 3.82	71.62	6.52	21.86

HONEY DRIP.

Honey drip canes are short, stocky, and strongly rooted. Their quality is poor.

Averages of analyses of Honey Drip.

1888.

Parent plot. 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
	100	Aug. 31 – Sept. 13	13	7	*Pr. cent.* 14.25	*Pr. cent.* 7.0$_4$	*Pr. cent.* 3.12	*Pr. cent.* 40.9	49.40	21.90	28.70

UFATANE.

This is a South African variety. The canes are of medium size and bear a heavy seed top. Sugar content fair.

Averages of analyses of Ufatane.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
(*)	18	Oct. 4 – Oct. 26	52	4	*Pr. cent.* 17.42	*Pr. cent.* 13.63	*Pr. cent.* .69	*Pr. cent.* 3.10	78.24	3.96	17.80

1890.

18.....	190	Sept. 12 – Oct. 3	21	4	16.40	11.03	1.33	4.04	67.26	8.11	24.63

* Unselected.

LARGE GOOSE NECK.

This variety never matured here.

Analysis of Large Goose Neck.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analysis.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
(*)	192	Oct. 7	1	1	*Pr.cent.* 10.60	*Pr. cent.* 2.34	*Pr. cent.* 4.92	*Pr.cent.* 3.34	22.08	46.41	31.51

*Unselected.

EARLY GOOSE NECK.

The seed of this variety was received from South Carolina, where it is highly recommended. Its goose-neck habit makes handling and topping the cane rather difficult. The quality of the juice is fair.

Averages of analyses of Early Goose Neck.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
(*)	75	Sept. 11 to Oct. 9	28	5	*Pr.cent.* 17.73	*Pr.cent.* 12.00	*Pr.cent.* 2.02	*Pr.cent.* 3.71	67.68	11.40	20.92

*Unselected.

UKUBANE.

Ukubane was tried last year. The sugar per cent was fair, but the variety was not deemed worth further trial.

Average of analyses of Ukubane.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
(*)	32	Sept. 21 to Oct. 11	20	4	*Pr.cent.* 18.58	*Pr. cent.* 13.65	*Pr. cent.* 1.43	*Pr.cent.* 3.50	73.47	7.69	18.84

* Unselected.

EARLY AMBER

Is at present the best early maturing variety. Earlier varieties have been grown here, but as a rule have not amounted to much. The canes of these very early kinds are always small and the juice poor and variable. The Amber for 3 years has given here moderate sugar per cents, rather high glucose, and low nonsugars. It has not a long working period, usually beginning to retrograde soon after maturity.

Averages of analyses of Early Amber.

1888.

Parent plot 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
(*)	92	Aug. 24 – Sept. 1	8	3	17.78	12.73	1.81	3.24	71.60	10.18	18.22
	231	Aug. 30 – Sept. 26	27	3	13.35	7.35	2.58	3.42	55.05	19.32	25.63
	237	Aug. 31 – Sept. 24	24	4	13.85	8.43	2.64	2.78	60.87	19.06	20.07
Mean					15.00	9.50	2.35	3.15	63.34	15.66	21.00

* Unselected.

1889.

	1	Sept. 21 – Oct. 26	35	4	15.33	11.50	1.41	2.42	75.02	9.20	15.78
	49	Sept. 21 – Oct. 25	34	5	15.93	11.59	1.21	3.13	72.75	7.60	19.65
	50	Sept. 21 – Oct. 11	20	4	15.78	11.80	1.28	2.70	74.78	8.11	17.11
	235	Aug. 30 – Sept. 23	24	12	16.22	11.88	1.10	3.24	73.23	6.77	20.00
Mean					15.81	11.69	1.25	2.87	73.94	7.91	18.15

1890.

(*)	14	Sept. 6 – Sept. 15	9	2	18.57	12.63	2.00	3.94	68.02	10.77	21.21
	25	Aug. 1 – Sept. 13	43	10	17.60	13.05	1.01	3.54	74.15	5.74	20.11
Mean					18.08	12.84	1.50	3.74	71.02	8.29	20.69

* Unselected.

THE ORANGES (NEEAZANA).

The varieties known as Early Orange, Late Orange, Kansas Orange New Orange, Improved Orange, and Rio Blanco, are much alike physically. All give short, stocky, well-rooted canes, and all have juices distinguished by a good sugar per cent and a high glucose and an extremely low nonsugar content. They all ripen at about the same time, there being little difference between Late and Early Orange in this respect, despite their names. Rio Blanco was brought here from Mexico last year.

Averages of analyses of Early Orange.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
(*)	83	Sept. 12 – Oct. 9	27	4	16.91	10.64	2.62	3.65	62.92	15.50	21.58
	228	Sept. 7 – Sept. 21	14	5	16.86	10.85	2.71	3.30	64.35	16.08	19.57
	236	Sept. 17 – Sept. 26	9	3	15.78	9.71	3.07	3.00	61.53	19.45	19.01
Mean.					16.52	10.40	2.80	3.32	62.93	17.02	20.05

1889.

	207	Sept. 12 – Oct. 9	27	6	17.38	11.88	3.12	2.38	68.36	17.95	13.69
	239	Sept. 9 – Oct. 11	32	7	17.14	12.12	2.19	2.83	70.71	12.78	16.51
	242	Sept. 9 – Oct. 11	32	7	15.46	10.66	2.41	2.39	68.95	15.59	15.46
	382	Oct. 5 – Oct. 14	9	4	18.63	13.83	2.35	2.45	74.23	12.62	13.15
Mean.					17.15	12.12	2.52	2.51	70.55	14.75	14.70

1890.

239	178	Sept. 2 – Oct. 4	32	5	18.94	13.65	2.15	3.14	72.08	11.35	16.57

* Unselected.

Averages of analyses of New Orange.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent*	*Pr. cent.*			
(*)	88	Sept. 5 – Sept. 27	22	4	15.27	7.77	4.32	3.18	50.88	28.29	20.83

1889.

	12	Sept. 18 – Oct. 25	37	5	18.59	13.75	1.99	2.85	73.90	10.71	15.39
	193	Sept. 20 – Oct. 12	22	7	18.72	13.66	2.74	2.32	72.98	14.63	12.39
	216	Sept. 27 – Oct. 7	10	3	18.65	13.65	2.07	2.93	73.18	11.10	15.72
	238	Sept. 16 – Oct. 25	39	7	18.65	13.53	2.20	2.92	72.54	11.80	15.66
Mean.					18.65	13.65	2.25	2.75	73.19	12.07	14.74

1890.

193	177	Sept. 13 – Sept. 26	13	3	19.43	14.05	2.66	2.69	72.46	13.69	13.85

* Unselected.

Averages of analyses of Improved Orange.

1889.

Parent p'ot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
	204	Oct. 24 – Oct. 26	2	2	17.84	12.96	2.31	2.57	72.65	12.95	14.40
	213	Sept. 21 – Oct. 1	10	4	18.75	13.95	2.58	2.22	74.40	13.76	11.84
	370	Oct. 3 – Oct. 10	7	2	20.27	14.05	3.02	3.20	69.32	14.90	15.78
	371	Sept. 18 – Oct. 10	22	4	16.76	12.12	2.09	2.55	72.31	12.47	15.22
Mean.					18.40	13.27	2.50	2.63	72.12	13.58	14.30

Averages of analyses of Rio Blanco.

1889.

Parent plot, 1888-'89.	Plot.	Dates.	Length of season in days.	No. of analyses	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr.cent.*	*Pr. cent.*			
(*)	107	Sept. 11 – Oct. 25	44	6	18.16	14.21	1.78	2.17	78.25	9.80	11.95

* Unselected.

1890.

107	102	Sept. 13 – Sept. 25	12	4	20.46	15.17	1.79	3.50	74.14	8.74	17.11
	103	Sept. 2 – Oct. 15	43	8	20.64	14.98	2.44	3.22	72.58	11.82	15.60
	183	Sept. 2 – Sept. 9	7	4	18.69	13.69	2.79	2.21	73.25	14.93	11.82
Mean					19.93	14.62	2.34	2.97	73.35	11.75	14.90

Averages of analyses of Late Orange.

1888.

Parent plot, 1888.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
	89	Sept. 19 – Oct. 9	20	2	17.50	11.65	2.69	3.16	66.56	15.38	18.06

1889.

	241	Sept. 27 – Oct. 25	28	5	18.61	14.41	1.65	2.55	77.43	8.86	13.71
	386	Oct. 5 – Oct. 11	6	3	18.86	13.99	2.46	2.41	74.18	13.04	12.78
Mean.					18.73	14.20	2.05	2.48	75.81	10.95	13.24

Average analyses of Kansas Orange.

1888.

Parent plot 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
	82	Sept. 19 Sept. 27	8	2	14.99	9.38	1.95	3.66	62.37	13.01	24.42

1889.

	200	Sept. 18 Oct. 1	13	5	18.17	13.62	1.85	2.70	75.00	10.14	14.88
	240	Sept. 9 Oct. 7	28	2	15.48	11.26	1.75	2.47	72.74	11.30	15.96
	390	Oct. 10 Oct. 26	16	2	17.71	13.11	.85	3.75	74.02	4.81	21.17
Mean..					17.11	12.66	1.48	2.97	74.00	8.65	17.35

1890.

200	181	Sept. 2 Sept. 27	25	4	17.67	11.80	2.65	3.22	66.78	15.00	18.22

GOLDEN ORANGE.

This variety was first grown here from some seeds taken from stray canes found in a field of Honduras in 1888. It does not resemble the other Orange varieties in its physical properties.

Average of analyses of Golden Orange.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
	117	Sept. 11 Oct. 12	31	9	17.18	13.15	1.82	2.21	76.54	10.59	12.87
	214	Sept. 21 Oct. 22	31	6	17.20	11.82	2.27	3.11	68.72	13.20	18.08
Mean.					17.19	12.48	2.04	2.67	72.60	11.86	15.54

1890.

	71	Sept. 2 Oct. 22	50	9	18.64	13.34	1.59	3.71	71.56	8.54	19.90
	72	Sept. 1 Oct. 13	42	8	18.69	13.78	1.80	3.11	73.73	9.63	16.64
Mean.					18.66	13.56	1.70	3.40	72.64	9.11	18.25

VARIETY No. 208.

This variety originated from a cross of Link's Hybrid and Early Amber.

Averages of analyses of Variety 208.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
	208	Sept. 12 – Oct. 9	27	7	19.03	14.78	.95	3.30	77.66	5.00	17.34

1890.

208 ...	59	Sept. 12 – Oct. 21	39	8	19.76	15.07	.77	3.92	76.26	3.90	19.84
208 ...	268	Sept. 26 – Oct. 15	19	3	19.27	15.25	1.01	3.01	79.14	5.24	15.62
Mean	....	.....	.....	.....	19.51	15.16	.89	3.46	77.70	4.57	17.73

VARIETY NO. 244.

This came from a cross of Link's Hybrid and Early Amber.

Averages of analyses of variety 244.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
	244	Oct. 3 – Oct. 25	22	5	19.39	15.32	.64	3.43	79.01	3.30	17.69

1890.

244 ...	63	Sept. 2 – Oct. 2	30	7	18.93	14.41	.76	3.76	76.12	4.02	19.86

DUTCHER'S HYBRIDS, NOS. 1, 2, AND 3.

Averages of analyses of Dutcher's Hybrids.

1890.—No. 1.

Parent plot. 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
(*)	193	Aug. 22 Sept. 13	22	4	16.72	12.43	1.22	3.07	74.34	9.30	18.36

No. 2.

(*)	194	Sept. 2 Sept. 13	11	3	17.22	13.08	1.46	2.68	75.96	8.48	15.56

No. 3.

(*)	195	Aug. 22 Sept. 13	22	5	16.87	12.10	1.37	3.40	71.73	8.12	20.15

* Unselected.

HONEY DEW.

This variety gives very good canes and plenty of white seed, which, however, is usually all taken by birds. The sugar per cent of the juice is low, the glucose relatively high, and the purity low.

Average of analyses of Honey Dew.

1890.

Parent plot. 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
(*)	175	Aug. 25 Sept. 23	29	6	16.85	11.47	1.35	4.03	68.07	8.01	23.92

* Unselected.

CHINESE IMPHEE.

Imphee canes are tall and slender.

Averages of analyses of Chinese Imphee.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
(*)	14	Sept. 14 to Oct. 11	27	6	18.08	13.81	.61	3.66	76.38	3.38	20.24

1890.

14.....	349	Sept. 6 to Oct. 3	27	4	18.73	14.03	.73	3.97	74.90	3.90	21.20

*Unselected.

VARIETY NO. 350.

This variety originated from a cross of Link's Hybrid and Orange. The parent cane was selected in 1888, and the seed head planted in lot 350 in 1889.

Averages of analyses of Variety 350.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
	350	Oct. 26	1	1	21.90	15.54	.....	.....	70.95	.....	.....

1890.

350....	60	Sept. 8 to Oct. 31	43	?	21.15	15.83	.94	4.38	74.85	4.44	20.71

VARIETIES NOS. 126 AND 127.

The seed of these two lots came from Australia. They are apparently the same variety. The canes of both are large and handsome. Both show high sugar, low glucose, high nonsugar, and good purity.

Averages of analyses of lots 126 *and* 127.

1890.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*			
	126	Sept. 9 to Oct. 15	36	6	19.62	15.02	.63	3.97	76.56	3.21	20.23
	127	Sept. 9 to Oct. 15	36	6	20.44	15.42	.41	4.61	75.44	2.01	22.55

VARIETY No. 289.

This variety originated from a cross of White India and Orange. The parent cane was picked out in 1888 and the seed head planted in plot 289 in 1889. The canes are short, sturdy, and strongly rooted. The sugar per cent is very high, the glucose low, and the nonsugar high The purity is very good.

Averages of analyses of Variety 289.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
	289	Oct. 3	1	1	*Pr.cent.* 19.40	*Pr. cent.* 15.47	*Pr. cent.* .59	*Pr. cent.* 3.34	79.74	3.05	17.21

1890.

289	90	Sept. 8 to Sept. 15	7	3	20.24	15.47	.84	3.93	76.43	4.15	19.42
	91	Sept. 8 to Oct. 13	35	6	20.79	15.91	.84	4.04	76.52	4.04	19.44
Mean					20.51	15.69	.84	3.98	76.47	4.09	19.43

VARIETY No. 112.

This variety originated in a sport found in a field of Honduras in 1888. The seed head was planted in plot 112 last year. The sugar per cent. is good and the glucose moderately low. The purity is good.

Averages of analysis of Variety No. 112.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analysis.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
	112	Sept. 17 – Oct. 12	25	7	18.62	14.23	1.08	3.31	76.42	5.80	17.78

1890.

112..	73	Sept. 2 – Oct. 2	30	6	18.74	14.30	1.14	3.30	76.31	6.08	17.61
	74	Sept. 2 – Oct. 13	41	7	17.82	13.25	1.15	3.42	74.35	6.45	19.20
	75	Aug. 27 – Oct. 3	47	7	17.79	13.09	1.09	3.61	73.59	6.12	20.29
Mean					18.12	13.55	1.13	3.44	74.75	6.22	19.03

VARIETY No. 110.

This variety originated from a sport found in a field of Honduras in 1888.

Averages of analyses of Variety No. 110.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent*	*Pr. cent.*	*Pr.cent.*			
	110	Sept. 17 – Sept. 27	10	4	17.81	14.25	.76	2.80	80.00	4.27	15.73

1890.

110	343	Sept. 6 – Sept. 12	6	2	18.69	13.89	.94	3.86	74.32	5.03	20.65

UNGATUBANDA.

This variety was grown last year only and but one analysis made then. The canes are fairly good.

Ungatubanda.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
	21	Oct. 1	1	1	*Pr.cent.* 15.93	*Pr. cent.* 12.17	*Pr. cent.* .81	*Pr.cent.* 2.95	76.40	5.08	18.52

DINDEMUKA.

The canes of this variety have each three to five seed heads, which is an undesirable characteristic. The per cent of sugar is fair and that of glucose moderate.

Averages of analyses of Dindemuka.

1889.

Parent plot. 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
(*)	37	Oct. 4 – Oct. 11	7	2	17.02	12.41	.83	3.78	72.92	4.87	22.21
	234	Sept. 6 – Oct. 26	50	9	16.52	12.00	1.54	2.98	72.64	9.32	18.04
Mean.	.....	.....	.....	.....	16.77	12.20	1.19	3.38	72.78	7.09	20.13

* Unselected.

1890.

37.....	187	Sept. 13 – Oct. 7	34	4	18.84	13.46	1.47	3.91	71.44	7.80	20.76

EARLY TENNESSEE.

Was grown in 1888 and 1889. It is not a desirable variety, having only early ripening to recommend it. The per cent of sugar is very low and those of glucose and non-sugar both high. It is extremely variable.

Averages of analyses of Early Tennessee.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
(*)	102	Aug. 21 Aug. 31	10	2	14.31	7.44	2.22	4.65	52.00	15.52	32.48

* Unselected.

1889.

102....	245	Sept. 2 Sept. 9	7	4	10.94	5.43	3.29	2 22	49.60	30.10	20.30

PLANTER'S FRIEND.

This variety came here from Australia, although originally a native of India. It is a handsome cane and gives a good tonnage. As improved by selection it has high sugar, rather high glucose, and about the average "other solids."

Averages of analyses of Planter's Friend.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr.cent.*	*Pr.cent.*	*Pr.cent.*			
(*)	231	Sept. 18 Oct. 24	36	4	18.58	12.15	1.78	4.65	65.39	9.58	25.03

* Unselected.

Averages of analysis of Planter's Friend—Continued.

1889.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugar.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr. cent.	*Pr. cent.*	*Pr. cent.*	*Pr. cent.*			
231..	177	Oct. 2 – Oct. 24	22	4	14.89	9.67	2.44	2.78	64.94	16.38	18.68
	180	Oct. 7 – Oct. 24	17	2	14.47	9.93	1.55	2.99	68.62	10.71	20.62
	181	Oct. 7 – Oct. 24	17	2	14.66	9.09	2.54	3.03	62.01	17.32	20.67
	182	Oct. 7 – Oct. 24	17	3	17.02	11.28	2.55	3.19	66.27	14.98	18.75
	184	Sept. 26 – Oct. 24	28	5	15.26	9.58	2.99	2.69	62.78	19.58	17.63
	185	Sept. 20 – Oct. 23	33	7	15.67	9.51	3.16	3.00	60.68	20.17	19.15
	186	Sept. 20 – Oct. 23	33	9	19.03	14.64	1.47	2.93	76.89	7.72	15.39
	188	Sept. 12 – Oct. 24	42	5	15.54	9.79	2.78	2.97	63.00	17.89	19.11
	189	Oct. 7 – Oct. 24	17	3	17.22	11.85	2.30	3.07	68.82	13.35	17.83
	191	Sept. 28 – Oct. 24	26	5	16.38	10.30	3.12	2.96	62.88	19.04	18.08
	190	Sept. 28 – Oct. 24	26	5	15.62	9.54	2.78	3.30	61.07	17.80	21.13
	376	Oct. 5 – Oct. 26	21	5	18.19	12.19	2.28	3.72	67.02	12.53	20.45
Mean					16.16	10.61	2.49	3.06	65.65	15.41	18.94

1890.

186..	106	Sept. 13 – Oct. 15	32	6	20.34	14.20	1.88	4.26	69.82	9.24	20.94
	107	Sept. 13 – Oct. 15	32	6	20.42	14.56	2.10	3.76	71.30	10.29	18.41
	273	Sept. 13 – Oct. 18	35	6	20.39	14.96	1.66	3.77	73.37	8.14	18.49
Mean					20.38	14.57	1.88	3.93	71.49	9.22	19.28

LIBERIAN.

This is an old and well-known variety. The seed is very small, and the plant in consequence is at first feeble. The sugar per cent is fair, the glucose rather high, and the non-sugar low.

Averages of analyses of Liberian.

1888.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
					Pr.cent.	*Pr. cent.*	*Pr. cent.*	*Pr.cent.*			
*	74	Sept. 17 – Oct. 9	22	5	18.28	11.84	3.07	3.37	64.77	16.79	18.44
*	222	Sept. 28 – Oct. 5	7	2	18.43	12.34	2.32	3.77	66.96	12.59	20.45
*	227	Sept. 20 – Sept. 26	6	2	16.57	10.99	2.02	3.56	66.32	12.20	21.48
Mean					17.76	11.72	2.46	3.58	66.00	13.85	20.16

* Unselected.

1889.

	27	Oct. 8 – Oct. 19	11	3	19.03	13.00	2.17	3.86	68.32	11.38	20.30
	124	Sept. 20 – Oct. 21	31	5	17.23	11.22	4.11	1.90	65.12	23.86	11.02
	125	Oct. 5 – Oct. 23	18	3	18.69	14.23	2.79	1.67	76.13	14.93	8.94
	126	Sept. 12 – Oct. 23	11	3	18.58	13.00	2.76	2.82	70.00	14.82	15.18
	127	Oct. 5 – Oct. 23	18	3	18.46	12.92	2.99	2.55	70.00	16.20	13.80
	128	Oct. 5 – Oct. 26	21	4	19.23	13.13	2.62	3.48	68.28	13.62	18.10
	129	Sept. 20 – Oct. 26	36	5	18.75	12.69	3.03	3.03	67.68	16.16	16.16
	130	Oct. 5 – Oct. 23	18	3	18.51	12.27	3.21	3.03	66.28	17.35	16.37
	133	Oct. 5 – Oct. 23	18	3	18.71	11.97	3.03	3.71	63.97	16.20	19.83
	134	Oct. 5 – Oct. 23	18	3	18.16	12.88	3.36	1.92	70.92	18.50	10.58
	136	Oct. 10 – Oct. 23	13	2	18.06	12.04	3.28	2.74	66.67	18.16	15.17
	138	Oct. 10 – Oct. 23	13	2	18.81	11.81	3.54	3.46	62.78	18.82	18.40
	139	Oct. 5 – Oct. 23	18	3	18.79	12.91	3.06	2.82	68.71	16.28	15.01
	140	Sept. 26 – Oct. 23	27	3	17.97	11.61	3.30	3.06	64.61	18.36	17.03
	141	Oct. 10 – Oct. 23	13	2	18.46	13.39	3.10	1.97	72.54	16.79	10.67
	142	Oct. 10 – Oct. 23	13	2	17.46	11.15	3.50	2.81	63.86	20.05	16.09
	144	Oct. 5 – Oct. 23	18	3	17.89	12.99	2.44	2.46	72.61	13.64	13.75
	145	Oct. 11 – Oct. 24	13	2	16.54	10.90	3.48	2.16	65.90	21.04	13.06
	243	Oct. 3 – Oct. 25	22	4	17.12	10.22	3.63	3.27	59.70	21.20	19.10
	315	Oct. 5 – Oct. 26	21	4	18.00	12.54	3.04	2.42	69.66	16.90	13.44
Mean					18.22	12.34	3.12	2.76	67.73	17.12	15.15

1890.

	108	Sept. 12 – Oct. 4	22	4	18.16	12.30	3.08	2.78	67.33	14.17	18.50
	109	Sept. 2 – Oct. 4	32	4	17.74	12.31	2.88	2.55	69.73	12.97	17.30
	131	Sept. 1 – Sept. 6	5	2	18.16	12.52	3.16	3.48	69.16	15.04	15.80
Mean					18.02	12.38	3.04	2.60	68.74	14.06	17.20

ALAPORE JOWAR.

This is a new variety the seed of which was received from India this year. The canes are short and small, with heavy compact seed heads and dark green leaves.

Average of analyes of Alapore Jowar.

Parent plot, 1888–'89.	Plot.	Dates.	Length of season in days.	No. of analyses.	In the juice.				Of the juice.		
					Solids.	Sucrose.	Glucose.	Solids, not sugars.	Purity or sucrose coefficient.	Glucose coefficient.	Non-sugars coefficient.
			22	3	*Pr. cent.* 17.75	*Pr. cent.* 12.55	*Pr. cent.* 0.76	*Pr. cent.* 4.44	70.70	4.28	25.02

WORK ON CROSSES.

In 1888, 150 plots were planted, each with seeds from a single crossed cane. In 1889, 250 similar plots were planted. In 1890, 355 plots were thus planted, and in all 755 plots were planted with cross-fertilized seeds, and many hundred analyses of the juices of hybrid canes were made to determine the possibility of producing improved varieties of sorghum by hybridization.

It appears that all the varieties can be cross-fertilized, and that a multitude of new varieties can thus be produced.

Not only do varieties which resemble each other and which flower and mature at the same time cross-fertilize, as for instance Kansas Orange and Early Orange, but very dissimilar varieties also cross-fertilize, as for instance, the small and early maturing Early Amber with the larger and later Link's Hybrid.

The principal part of the work has been done on crosses of the following varieties:

Amber and Orange.
Amber and Link's Hybrid.
Amber and White India.
Orange and White India.
Orange and White African.
Orange and Link's Hybrid.
Link's Hybrid and White India.
Link's Hybrid and Red Liberian.
Link's Hybrid and White African.

The first effect of a cross between varieties appears to be simply an alteration in the germs of the seeds which have been fertilized by pollen from another variety. This does not appear to influence or modify in any way the canes which produce the altered seeds. It follows from this that sorghum canes, grown from good seed, planted in close proximity to non-saccharine or inferior varieties produce as good canes for

sugar-making as when planted away from other varieties. But the seeds produced by the canes near inferior canes may be modified in the germs by pollen from the inferior canes, so that the canes produced in the next generation by these seeds may be variable in type, uneven in time of maturing, and inferior in quality.

The varieties of sorghum do not cross so readily as is popularly believed. In many cases at this station thousands of seeds of two varieties have been intentionally mixed and planted together in the hope of obtaining a desired cross. In some cases no crossed plants were produced; in other cases but a few crossed plants were found in the second generation, at which time the effects of cross-fertilization the previous year may be clearly seen. But while varieties of sorghum do not freely intermingle, yet cross-fertilization is effected under favorable conditions, and continuous planting of seeds which may contain but a few crossed seeds results finally in variable and mongrel seeds which produce canes which are uneven in ripening, uneven in sugar content, and not uniform in type.

The first effect observed, when cross-fertilized seeds are planted, is, in many cases, remarkably increased vigor of the crossed plants. The canes produced the first season after the cross-fertilization are often much larger and taller than canes of either of the parent varieties. The seeds and the seed heads are often remarkably large.

In looking over a field of cane it is safe to conclude that those canes which tower above the majority of the canes are crossed canes, or are stray canes from some larger variety. In selecting seed heads from a heap of cane tops, those which are remarkably large and fine it is safe to conclude are from crossed canes or from stray canes of larger varieties.

It follows from this that the common practice of selecting the largest and finest seed heads for planting leads to wrong results in two ways: It is in many cases a selection of seed from crossed and variable canes, which is especially to be avoided, and it is in any case a selection of seed from canes which tend more to grain production than to sugar production, for, as a rule, the largest grain-producing canes have produced less sugar.

The extraordinary vigor, the unusually large growth of cane, the large seeds, and the heavy seed tops are usually found only in canes produced by seeds which were cross-fertilized the season before, that is, in the first generation of canes. In many cases crossing appears to act as a temporary stimulant, the canes in subsequent generations being no more than ordinary size. But there have been cases at this station where seeds cross-fertilized in 1887 produced canes in 1889 and again in 1890 which were larger than the canes of either of the parent varieties.

When cross-fertilized seeds are planted the canes of the first generation usually show remarkable variations in type, many showing an evident approximation to one or other of the parent varieties. In most

cases the departure from the typical character of the parent variety covers the widest range from the least to the greatest variation. The "seedling" canes often differ from any known varieties. When it is remembered that a single seed head usually contains from 500 to 1,000 seeds, and that these seeds may have been cross-fertilized in different degrees, the cause of these variations is partly explained. But it also appears that cross-fertilization also "breaks up" a uniform variety and induces variations in type, and sometimes causes departures from any known types, so that the crossed plants differ in foliage, in habit of growth, in color of seed top, in size, in earliness of maturing, in fiber, and in quality of juice. The variations in form are apparent to the eye; the variations in the quality of the juice are shown by analysis. In the canes produced by one crossed seed head, one may have 8 per cent of sugar, another may have 16 per cent, so that it is often impossible to make comparable analyses by taking samples of canes intended to represent the average value of the plot.

In some cases apparent reversions to some old form or variety are seen in canes produced from one crossed seed head. For instance, it is generally supposed that the Early Amber variety originated in this country. Mr. Leonard Wray, however, insists that he imported it to this country in 1851 under the name Boomvwana, which signifies red. The Amber is a black-seeded variety. In a dozen lots of Amber crosses reversions to a scarlet or bright red variety were seen, a color not derived from either of the parent varieties of these crosses, but probably a reversion to the original color of the Boomvwana variety.

With sorghum, as with other plants, crossing varieties causes variations in size, in type, and in qualities. Unusual qualities are sometimes found in crossed plants, and there are two methods known of producing improved varieties of plants from single crossed plants which have the desired qualities.

The most common method consists in multiplying the selected plant by bud propagation, that is, by bulb or tuber, by suckers, by graft, by runners, layers, or by cuttings. When a plant is thus propagated by bud, the new plant is simply a continuation of the plant from which the bud was derived; no new plant is formed and the plant is multiplied until it becomes a variety, without variations. It is now known that sugar cane occasionally produces seed, and these seeds cross-fertilized have probably produced canes of unusual types, and these canes propagated by bud have perhaps formed the existing varieties of sugar cane. This method of propagation known and used by horticulturists allows at once the production of a uniform and improved variety from a single remarkable plant.

But this method appears not to be available for the production of improved varieties of sorghum, and the second method, propagation by seed, appears to be the only one practicable.

In this method cross-fertilized seeds are planted and from the vary-

ing canes produced by these seeds the cane having the most desirable qualities is selected, the seeds from the selected cane are planted, and selections are again made rejecting all variations, and the selections are repeated each year until the canes become uniform in type and in quality. By this method improved varieties of many plants have been produced, and these varieties reproduce themselves truly and uniformly by seed.

In the effort to produce improved varieties at this station from cross-fertilized seed it has been found that it is possible to produce a cane having unusually desirable qualities by cross-fertilization. That it is possible to select from the varying canes produced by the seeds of the selected cane a single cane which retains the same desired qualities. That it is possible by repeated similar selections to finally produce a new and improved and uniform variety which truly reproduces itself by seed. That in many cases a new and uniform variety is produced from a single crossed cane in 3 years, and then but slight reversions in type or variations in quality can be perceived. That some crosses are more persistent in tendency to reversions to the original types, and require more time to fix the new types, the tendency to reversion becoming less at each selection. That any desired character in form or size of cane, in percentage of sugar or glucose or of "other solids" may be found in the remarkable variations caused by hybridizing varieties, and that these qualities may be fixed by repeated selections from the cross fertilized canes.

This subject has been dwelt upon here, because the work at this station in improving varieties has been more successful in the production of improved varieties from crosses than in finding a superior variety by importation from foreign countries.

CULTURE EXPERIMENTS AT COLLEGE PARK, MARYLAND.

The experiments made in 1889 at College Park were rendered entirely futile by the exceptionally wet season, which prevented planting the cane at the proper time, interfered with its cultivation, and retarded its maturity. Hoping to obtain better results it was decided to continue the work, on a small scale, during the present season. Four acres of land were leased from Mr. D. M. Nesbit, and this land was divided into eight equal portions. The land was in the form of a parallelogram, the length lying east and west and was twice as long as it was wide. An attempt was made to secure land of a perfectly uniform nature, but even in so small a portion as 4 acres this was found to be impossible. The western part of the land was a gravelly loam, while about 1½ acres of its eastern portion was much more sandy and less fertile than the western part.

The eight subdivisions were planted north and south and were numbered by the letters of the alphabet beginning on the west side with plot A and continuing to the east end to plot H, each plot containing half an acre. In an eastern and western direction the plots were divided into five equal portions, and the numerals from 1 to 40 were applied to the small plots made by the crossing of the eight north and south divisions with the five east and west divisions, each plot containing one-tenth of an acre.

The method of plotting the field and the number of each plot are shown in the diagram.

On plots 1, 6, 11, 16, 21, 26, 31, 36, 3, 8, 13, 18, 23, 28, 33, 38, Link's Hybrid was planted; on plots 2, 7, 12, 17, 22, Early Amber; on plots 4, 9, 14, 19, 24, 29, 34, and 39, Undendebule; on plots 27, 32, 37, Red Liberian; on plots 5, 10, 15, and 20, Early Orange; on plots 25, 30, 35, and 40, Improved Orange and two rows of Early Orange to finish out the plot of which there was not enough Improved Orange seed to complete.

The principal object of the experiment was to determine the influence of different kinds of artificial fertilizers on the composition of the cane. The fertilizers employed and the method of distributing are indicated in the following scheme:

N

1	6	11	16
2	7	12	17
3	8	13	18
4	9	14	19
5	10	15	20

W E

S

A B C D

Link's Hybrid:
Plots 1, 6, 11, 16, 21, 26, 31, 36.
3, 8, 13, 18, 23, 28, 33, 38.

Early Amber:
Plots 2, 7, 12, 17, 22.

Undendebule:
Plots 4, 9, 14, 19, 24, 29, 34, 39.

N

21	26	31	36
22	27	32	37
23	28	33	38
24	29	34	39
25	30	35	40

W E

S

E F G H

Red Liberian:
Plots 27, 32, 37.

Early Orange:
Plots 5, 10, 15, 20.

Improved Orange:
Plots 25, 30, 35, 40.

Scheme for distributing fertilizers.

1.....Cotton-seed meal.
2.....Superphosphate.
3.....Kainite.
4.....Nitrate of soda.
5.....(1, 2, and 3) equal portions of each.
6.....(2, 3, and 4) equal portions of each.

On A.....No. 5.
On B.....No. 2.
On C.....Nothing.
On D.....No. 3.
On E.....No. 4.
On F.....Nothing.
On G.....No. 6.
On H.....No. 1.

Basis of application.

[Pounds per acre.]

No. 1	600	No. 4	400
No. 2	600	No. 5	600
No. 3	600	No. 6	600

In regard to taking samples for analysis the following plan was pursued:

Beginning, for instance, with the Early Amber, which was the first to ripen, samples of the cane were taken by cutting about one hundred canes of Early Amber from each of the different lettered plots on which it was planted, viz, A, B, C, D, and E. These canes were thrown together, well mixed, and divided into four parts, and one part sent to the laboratory for analysis. In this way samples were taken from each of the plots under the influence of each kind of fertilizer on the same day. On September 11, five samples of Early Amber were sent to the labaratory for analysis, including one sample from each of the lettered plots on which the Amber was grown. On the 19th, 24th, and 30th of September and 3d and 10th of October samples were taken in the same way from each of the plots of Amber. The other varieties were treated in the same way when they approached maturity, the object being to secure a study of the characteristics of the cane at about that period at which it would be used for manufacturing purposes if grown on a large scale.

The character of the cane was disappointing, with the exception of the Early Amber, indicating a crop which would have been unprofitable for manufacturing purposes.

With the exception of the Early Amber the growth of cane was luxuriant on all the plots except those at the extreme eastern end, in the poor ground. The Early Amber, as is usual with this variety, was very small as compared with the other varieties, and yet the yield per

acre was fair. The mean analyses of the Early Amber variety for the different plots are as follows:

	A	B	C	D	E
Total solids.....per cent..	17.5	17.7	17.1	16.7	16.0
Sucrose .....do....	13.4	13.1	12.9	12.1	11.4
Glucose.....do....	1.3	1.7	1.8	2.2	2.5
Purity	76.5	73.9	75.0	72.5	71.0

The analyses of the Early Orange were commenced on the 20th of September; subsequent sets of samples were examined on the 1st, 4th, 13th, 18th, and 30th of October. The mean results were as follows:

	A	B	C	D	E	F	G	H
Total solids, per cent.	14.5	15.3	15.0	14.5	15.5	15.3	15.2	16.1
Sucrose .....do....	7.7	8.9	8.4	8.1	9.9	9.7	9.7	10.6
Glucose.....do....	4.8	4.6	4.5	4.8	4.1	4.2	4.1	4.0
Purity	53.1	57.3	56.1	55.0	64.1	63.0	63.7	64.5

The analyses of Link's Hybrid were commenced on the 22d of September and continued on the 25th and 29th of September and the 6th, 11th, and 29th of October. The mean results obtained were as follows:

	A	B	C	D	E	F	G	H
Total solids, per cent.	14.6	14.9	14.4	14.3	15.8	15.1	14.7	15.9
Sucrose ..... do....	10.2	9.5	8.9	9.8	11.8	10.1	10.7	11.3
Glucose ..... do....	2.2	3.1	3.9	2.7	1.8	2.8	2.3	2.2
Purity	69.9	64.5	61.4	68.3	74.8	66.5	72.8	71.5

The analyses of Undendebule were commenced on the 26th of September and continued on the 2d, 17th, and 25th of October. The mean results obtained follow:

	A	B	C	D	E	F	G	H
Total solids, per cent.	13.5	14.2	14.6	15.0	15.9	15.6	16.3	16.1
Sucrose .....do....	9.3	8.9	9.1	11.3	11.2	10.2	11.4	10.9
Glucose.....do ..	2.4	3.3	3.3	2.1	2.2	2.8	2.6	2.4
Purity	68.4	62.3	62.4	75.3	74.0	65.1	69.6	67.6

The analyses of Improved Orange were commenced on the 16th of October and continued on the 21st and 27th. Following are the means obtained:

	E.	F.	G.	H.
Total solids.....per cent..	15.8	15.3	15.4	15.6
Sucrose.....do....	11.3	10.9	10.7	10.7
Glucose .....do....	3.8	4.2	4.0	4.0
Purity	71.1	71.3	70.0	68.5

Analyses of Red Liberian were commenced on the 15th of October and continued on the 20th and 28th. Following are the mean results obtained:

	F.	G.	H.
Total solids ..... per cent..	14.4	14.5	15.2
Sucrose ..... do....	3.9	4.5	5.2
Glucose ..... do....	6.6	6.5	6.2
Purity	26.8	30.4	33.9

In order to obtain a comparison in richness of sugar of the results on all the different plots with the different kinds of fertilizers, the following tabular arrangement has been constructed. Taking the mean results of each variety, they have been arranged in the following order:

First, in the order of highest sucrose; the plot giving, for instance, the highest sucrose being placed first and those containing the next subsequent percentages in order below. For instance, in the case of Early Amber, it was found that the highest sucrose was in plot A and there is a regular decrease from plot A, so that this was arranged in alphabetical order, A, B, and so on. In the next group are contained the plots with the lowest glucose, beginning with the lowest and continuing to the highest. In the next group are collected the mean purities, beginning with the highest purity and continuing to the lowest purity in order.

Classification of plots in respect of sucrose, glucose, and purity.

Variety.	Highest sucrose.								Lowest glucose.								Highest purity.							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Early Amber	A	B	C	D	E	..	..	..	A	B	C	D	E	..	..	..	A	C	B	D	E	..	..	..
Early Orange	H	E	F	G	B	C	D	A	H	G	E	F	C	B	D	A	H	E	G	F	B	C	D	A
Link's Hybrid ..	E	H	G	A	F	D	B	C	E	A	H	G	D	F	B	C	E	G	H	A	D	F	B	C
Undendebule	G	D	E	H	F	A	C	B	D	E	A	H	G	F	B	C	D	E	G	A	H	F	C	B
Improved Orange	E	F	G	H	...	...	...	...	E	F	G	H	...	...	..	...	F	E	G	H	...	...	...	...
Red Liberian	H	G	F	...	...	...	...	...	H	G	F	...	...	...	..	...	H	G	F	...	...	...	...	...

An analysis of this table shows that the plots have the following relations:

Plots.	Rank.								Total.
	1	2	3	4	5	6	7	8	
A.....	3	1	1	3	0	1	0	3	12
B.....	0	2	1	0	2	1	4	2	12
C.....	0	1	2	0	1	2	2	4	12
D.....	2	1	0	3	2	1	3	0	12
E.....	5	4	2	0	1	0	0	0	12
F.....	1	2	4	2	2	4	0	0	15
G.....	1	5	6	2	1	0	0	0	15
H.....	6	1	2	4	1	0	0	0	14

Per cent:

A for first place	25.0
B for first place	00.0
C for first place	00.0
D for first place	16.7
E for first place	42.7
F for first place	8.3
G for first place	8.3
H for first place	50.0

Multiplying each rank of each plot by the number of times it occurs and dividing by 8 will give the mean position of each plot in the series.

A = 6.25	E = 3.00
B = 8.37	F = 7.38
C = 8.63	G = 5.30
D = 6.63	H = 4.38

In reviewing these results the following facts are noticed: With Early Amber the highest sucrose was produced by fertilizer 5, followed in order by 2, 0, 3, and 4. The lowest glucose appears in same order.

The highest purity was found with No. 5, followed by 0, 2, 3, and 4.

With Early Orange the highest sucrose was produced with No. 4, followed in order by 2, 0, 3, and 5.

The lowest glucose was found with No. 4, followed by Nos. 0, 2, 3, and 5.

The highest purity was found with No. 4, followed in order by Nos. 2, 0, 3, and 5.

The above comparison, however, is not strictly just on account of the fact that all varieties were not planted on all the plots. It will be better, therefore, to compare only those plots and varieties which present a complete comparison. These plots are A, B, C, D, and E, and the varieties Early Amber, Early Orange, Link's Hybrid, and Undendebule.

Classification of plots A, B, C, D, and E, with varieties Early Amber, Early Orange, Link's Hybrid, and Undendebule.

Variety.	Highest sucrose.					Lowest glucose.					Highest purity.				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Early Amber	A	B	C	D	E	A	B	C	D	E	A	C	B	D	E
Early Orange	E	B	C	D	A	E	C	B	D	A	E	B	C	D	A
Link's Hybrid	E	A	D	B	C	E	A	B	D	C	E	A	D	B	C
Undendebule	D	E	A	C	B	D	E	A	B	C	D	E	A	C	B

With Link's Hybrid the highest sucrose was found with No. 4, followed in order by Nos. 5, 3, 2, and 0.

The lowest glucose was found with No. 4, followed in order by Nos. 5, 2, 3, and 0.

The highest purity was found with No. 4, followed in order by Nos. 5, 3, 2, and 0.

With Undendebule the highest sucrose was found with No. 3, followed in order by Nos. 4, 5, 0, and 2.

The lowest glucose was found with No. 3, followed in order by Nos. 4, 5, 2, and 0.

The highest purity was found with No. 3, followed in order by Nos. 4, 5, 0, and 2.

A general comparison of the numbers is given in the following table:

Plot.	Rank.					Total.
	1	2	3	4	5	
A	3	3	3	0	3	12
B	0	4	3	3	2	12
C	0	2	4	2	4	12
D	3	0	2	7	0	12
E	6	3	0	0	3	12

Multiplying the times each plot occurs in the series by the number of the rank and dividing by 5 we obtain the mean position of each plot.

1 E = 5.4 4 B = 7.8
2 A = 6.6 5 C = 8.8
3 D = 7.4

Hence it appears that in general results nitrate of soda (fertilizer applied to plot E) has produced the most favorable effects. Followed by this is a mixture of equal parts of cotton-seed meal, superphosphate, and kainite. Next in order comes kainite alone. In the next rank we find superphosphate alone; while the plot C, which received no fertilizer at all, showed the poorest results.

These data are more valuable in indicating the methods of studying the effects of intensive culture on sorghum than for the definite knowledge obtained. It is evident at once that only several years of continual investigation would make a solution of the problem possible.

The agricultural data are briefly given in the following résumé:

Plots A, B, C, and part of D were rather light soil, containing a large percentage of sand and having perfect natural drainage; the remainder of the plots were more clayey and compact. The light soil favored the growth of sorghum so that it matured on an average one month earlier than that in the other plots. It is worthy of note that the sorghum showed far greater sensitiveness to difference in soils than a field of corn grown next to it on the same kind of ground. The following statement gives the number of stalks per acre, and the gross weight per acre, including the blades and seed heads, and the net weight per acre including only the clean cane for each variety on the different plots. These weights were all taken on the same day, viz, the 15th of October, 1890, and the weight per acre is based upon a carefully meas-

ured portion of each plot, the whole of which was harvested and weighed in the manner indicated:

Plots.	Link's Hybrid.			Early Amber.			Undendebule.		
	Stalks per acre.	Gross weight per acre.	Net weight per acre.	Stalks per acre.	Gross weight per acre.	Net weight per acre.	Stalks per acre.	Gross weight per acre.	Net weight per acre.
		Pounds.	*Pounds.*		*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*
A	22,000	23,500	17,500	20,000	15,000	12,000	22,000	32,000	27,500
B	27,000	29,500	21,500	21,000	10,000	7,500	18,000	27,500	21,500
C	15,000	23,000	17,000	18,000	7,500	6,000	27,000	29,000	21,000
D	21,000	36,000	26,500	18,000	12,500	9,000	23,000	20,000	14,000
E	24,000	37,000	27,000	18,000	6,000	4,500	21,000	22,500	16,500
F	25,000	32,500	24,500	.....	.....	.....	21,000	24,000	16,500
G	21,000	25,500	19,000	.....	.....	.....	17,000	21,500	15,000
H	23,000	28,500	19,500	.....	.....	.....	20,000	22,000	15,000

Plots.	Early Orange.			Improved Orange.			Red Liberian.		
	Stalks per acre.	Gross weight per acre.	Net weight per acre.	Stalks per acre.	Gross weight per acre.	Net weight per acre.	Stalks per acre.	Gross weight per acre.	Net weight per acre.
		Pounds.	*Pounds.*		*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*
A	18,000	33,000	25,500	.....	.....	.....	.....	.....	.....
B	21,000	27,500	22,200	.....	.....	.....	.....	.....	.....
C	20,000	22,000	17,000	.....	.....	.....	.....	.....	.....
D	18,000	27,500	21,000	.....	.....	.....	.....	.....	.....
E	.....	.....	.....	17,000	13,500	10,000	.....	.....	.....
F	.....	.....	.....	18,000	14,500	10,500	21,000	30,000	23,000
G	.....	.....	.....	18,000	17,000	11,500	22,000	24,500	19,500
H	.....	.....	.....	17,000	18,000	13,000	14,000	22,500	16,500

The analytical data follow:

Analyses of sorghum from College Park, Prince George's County, Maryland.

Variety.	Plot.	Serial No.	When received.	In the juice.			
				Solids.	Sucrose.	Glucose.	Purity.
				Per cent.	*Per cent.*	*Per cent.*	
Early Amber	A	7430	Sept. 11	16.8	12.7	1.79	75.6
		7435	Sept. 19	18.2	13.8	1.20	75.8
		7452	Sept. 24	18.1	13.7	1.37	75.7
		7469	Sept. 30	18.0	13.8	1.47	76.7
		7481	Oct. 3	17.7	13.4	1.16	75.7
		7492	Oct. 10	16.4	13.0	1.30	79.3
				17.5	13.4	1.38	76.5
Early Amber	B	7431	Sept. 11	16.7	11.9	2.54	71.2
		7436	Sept. 19	17.8	13.5	1.53	75.9
		7453	Sept. 24	18.5	14.0	1.84	75.7
		7470	Sept. 30	17.8	13.1	1.79	73.6
		7482	Oct. 3	17.5	12.9	1.26	73.1
		7493	Oct. 10	17.8	13.2	1.28	74.1
				17.7	13.1	1.71	73.9
Early Amber	C	7432	Sept. 11	16.6	11.8	2.67	71.1
		7437	Sept. 19	16.8	12.8	1.72	76.2
		7454	Sept. 24	18.3	14.3	1.44	78.2
		7471	Sept. 30	17.2	13.0	2.04	75.6
		7483	Oct. 3	17.1	12.7	1.06	74.2
		7494	Oct. 10	16.8	12.5	1.93	74.5
				17.1	12.9	1.81	75.0
Early Amber	D	7433	Sept. 11	15.6	10.5	3.62	67.3
		7438	Sept. 19	16.2	11.4	2.09	70.3
		7455	Sept. 24	17.9	13.3	2.18	74.3
		7472	Sept. 30	16.6	12.2	2.44	73.5
		7484	Oct. 3	16.7	12.3	1.16	73.9
		7495	Oct. 10	17.0	12.9	1.86	75.8
				16.7	12.1	2.23	72.5

Analyses of sorghum from College Park, Prince George's County, Maryland—Continued.

Variety.	Plot.	Serial No.	When received.	In the juice.			
				Solids.	Sucrose.	Glucose.	Purity.
				Per cent.	*Per cent.*	*Per cent.*	
Early Amber	E	7434	Sept. 11	15.6	10.5	3.40	67.3
		7439	Sept. 19	15.2	9.9	2.45	65.1
		7456	Sept. 24	16.9	12.7	2.10	75.2
		7496	Oct. 10	16.2	12.4	2.10	76.5
				16.0	11.4	2.51	71.0
Early Orange	A	7440	Sept. 20	14.8	6.1	6.67	41.2
		7473	Oct. 1	14.3	7.3	4.81	51.0
		7485	Oct. 4	15.5	9.0	4.59	58.0
		7501	Oct. 13	13.5	8.9	3.81	65.9
		7528	Oct. 18	14.2	7.0	4.31	49.3
				14.5	7.7	4.84	53.1
Early Orange	B	7441	Sept. 20	15.2	6.9	6.02	43.4
		7474	Oct. 1	15.9	9.9	4.25	62.3
		7486	Oct. 4	15.5	8.9	4.85	57.4
		7502	Oct. 13	14.5	8.9	4.20	61.3
		7529	Oct. 18	15.4	9.7	3.57	62.3
				15.3	8.9	4.58	57.3
Early Orange	C	7442	Sept. 20	15.8	8.4	5.26	53.1
		7475	Oct. 1	14.3	8.6	4.50	60.1
		7487	Oct. 4	15.1	8.7	4.10	57.6
		7530	Oct. 18	14.8	7.9	4.23	53.4
				15.0	8.4	4.52	56.1
Early Orange	D	7443	Sept. 20	12.3	4.7	6.10	38.2
		7476	Oct. 1	14.5	7.8	4.74	33.8
		7504	Oct. 13	15.5	10.3	4.50	66.4
		7531	Oct. 18	15.8	9.7	3.84	61.4
				14.5	8.1	4.79	55.0
Early Orange	E	7505	Oct. 13	16.3	10.4	4.39	63.8
		7509	Oct. 14	14.9	10.2	3.73	69.0
		7532	Oct. 18	15.8	10.3	3.97	65.2
		7572	Oct. 30	15.1	8.8	4.10	58.3
				15.5	9.9	4.05	64.1
Early Orange	F	7506	Oct. 13	15.9	10.0	4.42	62.8
		7510	Oct. 14	14.5	10.6	4.13	73.1
		7533	Oct. 18	15.4	8.6	4.06	55.8
		7573	Oct. 30	15.3	9.4	4.10	60.4
				15.3	9.7	4.18	63.0
Early Orange	G	7507	Oct. 13	15.5	10.1	4.34	65.1
		7511	Oct. 14	14.3	9.6	3.84	67.1
		7534	Oct. 18	16.4	10.6	3.84	64.6
		7574	Oct. 30	14.5	8.4	4.20	57.9
				15.2	9.7	4.05	63.7
Early Orange	H	7508	Oct. 13	15.9	10.7	4.16	61.0
		7512	Oct. 14	14.9	9.8	4.10	65.8
		7535	Oct. 18	16.6	10.7	3.70	64.5
		7575	Oct. 30	16.8	11.2	4.00	66.7
				16.1	10.6	3.99	64.5
Link's Hybrid	A	7444	Sept. 22	14.8	10.4	2.25	70.3
		7457	Sept. 25	13.9	9.3	2.23	66.9
		7465	Sept. 29	13.7	9.3	2.19	67.9
		7488	Oct. 6	13.5	8.9	2.50	65.9
		7497	Oct. 11	15.1	10.9	2.22	74.0
		7566	Oct. 29	16.5	12.3	1.87	74.6
				14.6	10.2	2.21	69.9
Link's Hybrid	B	7445	Sept. 22	15.4	10.3	2.85	66.8
		7458	Sept. 25	14.9	9.2	3.47	61.7
		7466	Sept. 29	14.1	8.9	3.03	63.1
		7489	Oct. 6	14.1	9.0	2.97	63.8
		7498	Oct. 11	15.3	10.3	2.96	67.3
				14.9	9.5	3.05	64.5

Analyses of sorghum from College Park, Prince George's County, Maryland—Continued.

Variety.	Plot.	Serial No.	When received.	In the juice.			
				Solids.	Sucrose.	Glucose.	Purity.
				Per cent.	*Per cent.*	*Per cent.*	
Link's Hybrid	C	7446	Sept. 22	14.1	8.3	3.33	58.8
		7459	Sept. 25	13.7	7.7	3.54	56.2
		7467	Sept. 29	14.9	9.1	3.54	61.1
		7490	Oct. 6	14.1	8.6	3.45	60.9
		7499	Oct. 11	15.7	9.9	3.65	63.0
		7567	Oct. 29	13.9	9.5	3.35	68.4
				14.4	8.9	3.48	61.4
Link's Hybrid	D	7447	Sept. 22	14.3	9.1	3.06	63.6
		7460	Sept. 25	13.7	9.0	2.77	65.7
		7468	Sept. 29	14.3	8.9	3.33	62.2
		7491	Oct. 6	14.3	10.0	2.17	69.9
		7500	Oct. 11	15.1	10.9	2.82	72.3
		7568	Oct. 29	13.9	10.6	2.12	76.3
				14.3	9.8	2.71	68.3
Link's Hybrid	E	7448	Sept. 22	15.2	10.7	1.97	70.4
		7543	Oct. 22	16.1	11.6	2.08	72.0
		7547	Oct. 24	15.4	12.0	1.85	77.9
		7569	Oct. 29	16.5	13.0	1.41	78.8
				15.8	11.8	1.83	74.8
Link's Hybrid	F	7449	Sept. 22	14.8	9.1	3.27	61.4
		7544	Oct. 22	15 0	10.3	2.66	68.6
		7548	Oct. 24	15.5	10.8	2.59	69.6
				15.1	10.1	2.84	66.5
Link's Hybrid	G	7450	Sept. 22	15.4	10.5	2.63	68.1
		7545	Oct. 22	14.5	10.9	2.07	75.2
		7549	Oct. 24	14.6	10.8	2.24	73.9
		7570	Oct. 29	14.3	10.7	2.17	74.0
				14.7	10.7	2.28	72.8
Link's Hybrid	H	7451	Sept. 22	16.4	11.3	2.64	68.9
		7546	Oct. 22	15.8	11.1	2.14	70.2
		7550	Oct. 24	16.3	11.8	2.03	72.4
		7571	Oct. 29	14 9	11.1	2.10	74.5
				15.9	11.3	2.23	71.5
Undendebule	A	7461	Sept. 26	13.6	9.7	1.94	71.3
		7477	Oct. 2	12.2	7.8	2.82	63.9
		7520	Oct. 17	12.7	7.9	2.17	62.2
		7551	Oct. 25	15.5	11.8	2.46	76.1
				13.5	9.3	2.35	68.4
Undendebule	B	7462	Sept. 26	14.4	8.6	3.29	59.7
		7478	Oct. 2	13.5	7.8	3.59	57.8
		7521	Oct. 17	13.4	7.9	3.38	59.0
		7552	Oct. 25	15.6	11.3	2.96	72.5
				14.2	8.9	3.30	62.3
Undendebule	C	7463	Sept. 26	14.0	8.8	2.99	63.9
		7479	Oct. 2	13.9	7.9	3.70	56.8
		7522	Oct. 17	15.0	9.4	3.33	62.7
		7553	Oct. 25	15.4	10.4	3.22	67.3
				14.6	9.1	3.31	62.4
Undendebule	D	7464	Sept. 26	15.0	11.1	1.94	74.0
		7480	Oct. 2	14.5	10.9	2.04	75.2
		7523	Oct. 17	15.0	11.6	2.08	77.3
		7554	Oct. 25	15.4	11.5	2.19	77.4
				15.0	11.3	2.06	75.3
Undendebule	E	7524	Oct. 17	15.6	11.0	2.01	70.5
		7555	Oct. 25	16.2	11.4	2.37	70.3
				15.9	11.2	2.19	70.4

Analyses of sorghum from College Park, Prince George's County, Maryland—Continued.

Variety.	Plot.	Serial No.	When received.	In the juice.			
				Solids.	Sucrose.	Glucose.	Purity.
				Per cent.	*Per cent.*	*Per cent.*	
Undendebule	F	7525	Oct. 17	15.0	9.8	3.22	65.3
		7556	Oct. 25	16.2	10.5	2.38	64.8
				15.6	10.2	2.80	65.1
Undendebule	G	7526	Oct. 17	16.2	11.5	2.32	71.0
		7557	Oct. 25	16.4	11.2	2.96	68.2
				16.3	11.4	2.64	69.6
Undendebule	H	7527	Oct. 17	16.1	11.2	2.32	69.6
		7558	Oct. 25	16.0	10.5	2.46	65.6
				16.1	10.9	2.39	67.6
Improved Orange	E	7516	Oct. 16	15.2	10.8	4.16	71.1
		7539	Oct. 21	16.0	11.4	3.70	71.2
		7559	Oct. 27	16.3	11.6	3.49	71.1
				15.8	11.3	3.78	71.1
Improved Orange	F	7517	Oct. 16	14.0	10.2	4.20	72.9
		7540	Oct. 21	15.8	11.3	4.31	71.5
		7560	Oct. 27	16.1	11.2	3.97	69.5
				15.3	10.9	4.16	71.3
Improved Orange	G	7518	Oct. 16	15.0	10.7	3.73	71.3
		7541	Oct. 21	15.8	10.7	4.23	67.7
		7561	Oct. 27	15.3	10.8	4.00	70.6
				15.4	10.7	4.00	70.0
Improved Orange	H	7519	Oct. 16	15.0	10.3	4.10	68.7
		7542	Oct. 21	16.0	10.9	4.23	68.1
		7562	Oct. 27	15.7	10.8	3.67	68.7
				15.6	10.7	4.00	68.5
Red Liberian	F	7513	Oct. 15	14.2	4.5	6.17	31.7
		7536	Oct. 20	14.2	3.4	6.76	23.9
		7563	Oct. 28	14.9	3.7	6.94	24.9
				14.4	3.9	6.62	26.8
Red Liberian	G	7514	Oct. 15	14.2	4.0	6.41	28.2
		7537	Oct. 20	14.8	4.9	6.10	33.1
		7564	Oct. 28	15.0	4.5	7.04	30.0
				14.5	4.5	6.52	30.4
Red Liberian	H	7515	Oct. 15	15.0	5.7	5.95	38.0
		7538	Oct. 20	15.0	4.7	6.17	31.3
		7565	Oct. 28	15.7	5.1	6.41	32.5
				15.2	5.2	6.18	33.9

EXPERIMENTS AT THE MISSISSIPPI AGRICULTURAL EXPERIMENT STATION, STARKVILLE, MISSISSIPPI.

Quite a number of the seed heads selected at the Sterling Station in 1889 were sent to the director of the Mississippi Agricultural Experiment Station, Prof. S. M. Tracy, with the request that he coöperate with the Department in testing the value of the different varieties sent in the soil and climate of Mississippi. The cultivation of the samples was undertaken solely at the expense of the Mississippi Station, and in the analyses the Department of Agriculture furnished only the hand mill which was used in expressing the juice from the canes. The analyses were made by Mr. L. G. Patterson, the chemist of the experiment station. A review of the analytical data obtained strongly illustrates the statement which has already been made that the production of a superior variety of cane by selection in one locality will not always insure the development of similar canes from seeds which are planted at a great distance from the original station, where the conditions of soil and climate are quite unlike those under which the standard variety of cane has been developed.

In a variety of Red Liberian No. 137, coming from a cane whose juice showed a content of total solids equal to 19 per cent, analyses were made at the Starkville Station beginning September 1 and running to September 10, in which the content of sucrose in the juice of the cane varied from nothing to 4.9 per cent, while the glucose varied from 5 to 7.45 per cent. The mean numbers were sucrose, 3.0 per cent; glucose, 6.07 per cent. It seems hardly possible that a selected seed head could deteriorate so rapidly in being removed to a different locality. Analyses were continued with this variety planted from a seed head from plot No. 138 of the 1889 Sterling number, showing 18° Brix; No. 125 with a sucrose content of 15.04 per cent; No. 135, showing 18° Brix and No. 125 bis with 14.81 per cent of sucrose. These experiments were continued from September 1 to October 2, but in no case was the result comparable with the character of the parent cane. The percentage of glucose was almost uniformly higher than that of sucrose, and the result of the experiments with this series of selected seed heads was a record of most remarkable deteriorations. In several cases the polariscope failed to reveal any sucrose whatever present in the juices of the cane.

The mean percentages obtained in the juice were as follows:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent*
138	12.2	4.8	4.6
125	12.2	4.2	4.7
135	11.8	4.3	4.8
125 bis	14.1	6.0	4.8

Experiments were also made with selected seed heads from the Undendebule variety of cane selected at Sterling last year and of the following descriptions: Plot No. 297 of 18° Brix; No. 31, of 21° Brix; No. 31, of 20° Brix; No. 254, of 15.53 per cent sucrose. These analyses were commenced on the 2d of October, and continued until the 4th of October. In many cases good results were obtained, but in no case was the parent cane excelled. With stalks produced from seed-head plot No. 254, analyzed on the 3d of October, the sample was found to contain 15.2 per cent of sucrose and 0.54 per cent of glucose, and showing 20° Brix. Many of the other analyses showed fairly good percentages, but the mean of all of them would indicate a general deterioration in the most marked degree from the parent canes. Seed head from plot 31, 21° Brix, is a partial exception.

The mean results follow:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
297	12.0	6.4	1.7
31	18.3	13.1	1 4
31 bis	12.1	6.7	2.0
254	15.6	10.5	1.3

Analyses of the variety Rio Blanco were made on October 4. The samples were taken from canes grown from seed head from plot 107, of 21° Brix, and from seed-head plot 107, of 20° Brix. The results here also showed the most remarkable deterioration. In no case did the Brix of the samples grown equal that of the parent cane.

The means were as follows:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
107	13.3	7.8	3.8
107 bis	15.2	9.2	3.5

Experiments were also made with the India and Orange variety from Sterling, plot 289 of 1889, showing 21° Brix, and from selected seed head 14,175 of India and Orange, showing a sucrose content of 16.42 per cent, the experiments having been made on the 4th and 6th of October. In these cases, also, there was a marked deterioration. In the case of the canes developed from seed head No. 14,175, the highest percentage of sucrose reached was 13, with a glucose content of 1.73 per cent and 18° Brix. This was on the 6th of October. The lowest sucrose content was 4.2 per cent. The average is far below the

percentage of sucrose in the original cane, which, as before stated, was 16.42. Means:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
289	14.7	9.6	2.9
14,175	15.9	10.1	2.8

Experiments made with a variety of Honduras, grown from seed head 12,677, with a sucrose content of 16.72 per cent, showed the same reversion, only in a much more marked degree.

Experiments with Sorghum Bicolor, seed head No. 13,799, with a sucrose content of 13.25 per cent, also failed to develop as rich a cane as the parent, the highest percentage of sucrose found being 12.2, with a percentage of glucose of 0.83 u. c. means.

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
13,799	14.3	8.4	1.1

Experiments were made on the 11th of October with Link's Hybrid variety, from plot 194, seed head 11,586, with a sucrose content of 16.01 per cent. The results also were very poor, the highest sucrose content obtained being 10.3 per cent. Means:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
194	14.7	7.6	4.3

Red Liberian, examined on the 11th of October, from seed head No. 13,631, showing a sucrose content of 13.52 per cent, gave somewhat better results than the same variety examined earlier in the season, the highest sucrose found being 11 per cent. From the same variety, seed head 13,655, showing 13.97 per cent sucrose, the results were poorer, the highest sucrose content found being 9.1 per cent.

The means were:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
13,631	14.4	8.5	1.9
13,655	13.7	6.2	4.5

From a cross of Amber and Orange, seed head 13,927 having a sugar content of 16.85 per cent, much better results were obtained. The examination was made on the 17th of October. The percentages of su-

crose obtained in the samples examined on that day were as follows: 15.1, 13.6, 14.2, 11.9, 13.5, 13.5, 11.9, 14.1, 13.7, and 12.9.

The percentages of glucose in all except three instances fell below 1, while the purities were very high. This sample appears to have given the best and most uniform results of any examined during the season.

The mean data are:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
13, 927	17.6	12.5	0.75

On the 18th of October analyses were made of Link's Hybrid again from seed head 11,491, showing a sucrose content of 16.69 per cent, the results being also favorable. The percentages of sucrose were 13.8, 15, 12.6, 13.4, and 14.3, the glucose averaging about 1 per cent, and the purity being high. Analyses of the same plot, continued on the 20th of October, showed results equally good The means for the two days are:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
11, 491.....	18.4	13.6	1.2

Samples of Link's Hybrid, from seed head 13,897 with a sucrose content of 15.66 per cent, analyzed on the 20th of October, gave less favorable results, the highest sucrose content found being 14.5 per cent, and the lowest 8.8 per cent. Samples from another plot, grown from seed head 11,558, showing a sucrose content of 16.21 per cent, gave still less favorable results, and the same is true of another plot grown from seed heads Nos. 13,379 and 11,585. The means are:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
13, 897.....	17.0	11.6	1 5
11, 558.....	15.0	9.6	1.8
13, 379	15.1	9.5	2.4

Red Liberian examined later in the season, namely, on October 29, still showed the same extremely poor characteristics as were manifested in the earlier part of the season, with the exception of canes grown from seed head from plot 127, showing Brix 19.5°. The means from this plot were:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
127.....	19.5	14.6	1.2

The analyses were completed on the 31st of October by the examination of a sample of a cross of Amber and Orange from seed head No. 12,142 with a sucrose content of 17.99 per cent. In the three samples examined the sucrose was 15.0, 12.5, and 13.8 per cent, and the glucose 1.01, 2.17, and 1.72 per cent, and the Brix 19.5°, 18.0°, and 18.0° Means:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
12, 142	18.5	13.8	2.0

In general, it may be said that the Red Liberian, which has done fairly well in Kansas, was a total failure in Mississippi with the exception of one plot. The same is true but in a less degree of the Undendebule, although some analyses of this last variety were quite favorable, but the average of them all will show a much lower percentage of sucrose than in Kansas. Rio Blanco, which is a kind of Orange cane, also did very poorly in Mississippi, and the same is true of the cross of India and Orange. The Honduras in Mississippi, as elsewhere, has shown itself to be a worthless cane for sugar purposes. Sorghum bicolor also did poorly in Mississippi. The best results obtained were from the cross of Amber and Orange, the one plot of Red Liberian, and Undendebule from plot 254, seed head 13336, of which the mean analyses showed:

Plot No.	Total solids.	Sucrose.	Glucose.
	Per cent.	*Per cent.*	*Per cent.*
254.....	18.7	14.8	0.57

This brief review of the data obtained at the Mississippi station tends to show that if sorghum sugar culture is to become a success in that locality it will be quite necessary that a line of experiments in seed selection should be carried on similar to those which have produced such excellent results in Kansas. There is every reason to believe that by the pursuit of the same policy all the standard varieties of cane might be developed which would be as suitable to the soil and climate of Mississippi as those which have been developed in Kansas are to the meteorological conditions of that locality. Still, it must not be forgotten that the general tendency of the researches of the Department has been to show that sorghum does better in a semi-arid locality, and that therefore we ought not to expect as high a development in sugar-producing qualities in Mississippi as can be obtained in more arid regions.

CHARACTERISTICS OF THE SEASON

The season presented no special character until September, when rains became very frequent. From the average record of the weather during the growing season it will be noticed that there were 15 days of

rain in September and only 5 in October. It will be noticed also from the data of analyses which are appended that the sugar content of the juice was very low during the rainy season in September, and during October the sugar content rose rapidly until, in some cases, it reached almost as high a point as in Kansas.

The cane was planted in very rich creek bottom and no fertilizers were employed. In all, 235 plots were planted. The canes were thinned out in the early part of cultivation until they were left about 1 foot apart in the rows.

In taking samples 10 average stalks were selected, the juice expressed from them, and the analyses made thereon.

The record of the observer of the Signal Office for the period of growth follows:

United States Signal Service summary for 1890.

[Place of observation: Agricultural College, county of Oktibbeha, State of Mississippi. Latitude 33°, 26′, 30″. Longitude 88. Height of ground above sea, 422.4 feet.]

	Monthly mean temperature.	Monthly mean relative humidity.	Average monthly maximum temperature.	Average monthly minimum temperature.	Precipitation.		
					Rain in inches.	No. of rainy days.	Hours of sunshine.
May	70.5	79.3	79.5	61.9	4.35	9	288½
June	81.6	75.7	89.7	73.1	3.20	6	330½
July	81.2	78.8	88.7	73.1	3.47	11	281½
August	77.8	82.3	85.3	69.5	5.83	8	284
September	70.3	89.4	78.9	66.2	6.74	15	185½
October	63.2	83.5	70.6	53.6	3.90	5	209
November	58.3	79.3	68.1	48.2	0.01	1	194½
Sums	502.9	568.3	560.8	445.6	27.50	.....	1,773½
Averages	71.8	81.2	80.1	63.7	3.93	.....	257.7

J. M. WHITE,
Meteorologist.

JANUARY 12, 1891.

ANALYTICAL DATA.

The analytical data of the culture work in Mississippi are given below. Under the head "description of parent seed head" are given the data describing the parent seed heads recorded in the pedigree books of the Department.

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Red Liberian	137, Brix 19, Oct. 21	Sept. 29	1	10.5	1.5	5.78
Do	....do	Sept. 29	2	13.0	4.9	5.74
Do	....do	Sept. 29	3	8.5	.0	7.45
Do	....do	Sept. 29	4	12.5	4.0	5.00
Do	....do	Sept. 29	5	12.5	4.0	6 37
Do	....do	Sept. 29	6	11.0	3.9	5.55
Do	....do	Sept. 29	7	12.0	3.8	5.98
Do	....do	Sept. 29	8	11.5	2.9	6.28
Do	....do	Sept. 29	9	9.5	1.0	6.06
Do	....do	Sept. 29	10	13.0	4.3	6.45
Means	.....	.....	.....	11.4	3.0	6.07

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Red Liberian	138, Brix 18, Oct. 21	Sept. 29	11	11.5	5.3	4.54
Do	do	Sept. 29	12	10.5	2.6	5.15
Do	do	Sept. 29	13	14.0	7.3	4.08
Do	do	Sept. 29	14	15.5	9.2	4.23
Do	do	Sept. 29	15	14.5	8.1	3.98
Do	do	Oct. 1	16	11.0	1.4	5.68
Do	do	Oct. 1	17	7.5	.0	4.27
Do	do	Oct. 1	18	12.0	4.1	4.95
Do	do	Oct. 1	19	12.0	3.8	5.00
Do	do	Oct. 1	20	13.0	6.1	4.15
Means				12.2	4.8	4.60
Red Liberian	125, 13254, Sucrose 15.04, Oct. 11	Oct. 1	21	12.0	4.8	4.54
Do	do	Oct. 1	22	13.0	4.8	4.88
Do	do	Oct. 1	23	12.0	3.1	5 23
Do	do	Oct. 1	24	7.5	.0	4.45
Do	do	Oct. 1	25	13.0	4.6	4.65
Do	do	Oct. 1	26	12.0	3.6	5.15
Do	do	Oct. 1	27	11.0	2.2	5.07
Do	do	Oct. 1	28	14.5	6.7	4.32
Do	do	Oct. 1	29	14.0	5.9	4.38
Do	do	Oct. 1	30	13.0	6.5	4.76
Means				12.2	4.2	4.74
Red Liberian	135, Brix 18	Oct. 1	31	13.0	6.0	4.44
Do	do	Oct. 1	32	13.0	5.9	4.23
Do	do	Oct. 1	33	10.5	3.3	4.83
Do	do	Oct. 1	34	10.0	2.0	5.28
Do	do	Oct. 1	35	12.0	4.3	5.15
Do	do	Oct. 1	36	11.5	4.6	4.76
Do	do	Oct. 1	37	10.5	2.7	5.02
Do	do	Oct. 1	38	13.0	4.9	4.92
Do	do	Oct. 1	39	12.0	3.9	4.76
Do	do	Oct. 1	40	12.5	5.3	4.76
Means				11.8	4.3	4.82
Red Liberian	125, 13258, Sucrose 14.81	Oct. 2	41	14.0	6.3	4.63
Do	do	Oct. 2	42	14.0	6.2	4.80
Do	do	Oct. 2	43	16.0	8.9	4.13
Do	do	Oct. 2	44	12.0	1.8	6.25
Do	do	Oct. 2	45	11.5	3.5	5.13
Do	do	Oct. 2	46	15.0	5.9	5.02
Do	do	Oct. 2	47	14.0	5.7	4.76
Do	do	Oct. 2	48	15.5	7.9	4.85
Do	do	Oct. 2	49	13.5	5.5	4.92
Do	do	Oct. 2	50	15.0	8.5	3.09
Means				14.1	6.0	4.76
Undendebule	297, Brix 18	Oct. 2	51	13.0	7.8	1.60
Do	do	Oct. 2	52	11.0	4.6	2.64
Do	do	Oct. 2	53	15.0	9.1	1.69
Do	do	Oct. 2	54	16.5	10.7	.92
Do	do	Oct. 2	55	10.5	4.7	1.78
Do	do	Oct. 2	56	15.0	9.8	1.25
Do	do	Oct. 2	57	6.5	1.6	1.69
Do	do	Oct. 2	58	10.0	4.3	1.67
Do	do	Oct. 2	59	11.5	6.0	2.00
Do	do	Oct. 2	60	11.0	5.0	1.85
Means				12.0	6.4	1.71
Undendebule	31, Brix 21, Oct. 2	Oct. 2	61	17.5	12.0	1.70
Do	do	Oct. 2	62	16.5	11.6	1.50
Do	do	Oct. 2	63	17.5	13.0	1.43
Do	do	Oct. 2	64	17.5	12.5	1.41
Do	do	Oct. 2	65	17.5	12.8	1.23
Do	do	Oct. 3	66	20.0	14.2	1.16
Do	do	Oct. 3	67	20.5	14.7	1.08
Do	do	Oct. 3	68	17.5	12.8	1.66
Do	do	Oct. 3	69	20.5	14.5	1.00
Do	do	Oct. 3	70	18.0	13.0	1.30
Means				18.3	13.1	1.35

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Undendebule	31, Brix 20, Oct. 4	Oct. 3	71	8.0	2.2	2.50
Do	do	Oct. 3	72	14.0	9.4	1.45
Do	do	Oct. 3	73	13.5	8.3	1.76
Do	do	Oct. 3	74	13.5	7.5	2.21
Do	do	Oct. 3	75	12.5	6.8	2.30
Do	do	Oct. 3	76	11.0	4.8	2.27
Do	do	Oct. 3	77	12.0	7.1	1.44
Do	do	Oct. 3	78	10.5	5.7	2.24
Do	do	Oct. 3	79	13.5	8.1	1.63
Do	do	Oct. 3	80	12.5	6.8	2.39
Means				12.1	6.7	2.03
Undendebule	254, 11749, sucrose 15.53	Oct. 3	81	18.0	13.3	.97
Do	do	Oct. 3	82	20.0	15.2	.54
Do	do	Oct. 3	83	12.0	6.4	1.90
Do	do	Oct. 3	84	17.0	12.2	1.26
Do	do	Oct. 3	85	8.5	3.7	2.05
Do	do	Oct. 3	86	14.5	9.4	1.05
Do	do	Oct. 3	87	17.0	12.3	1.07
Do	do	Oct. 3	88	19.0	13.1	.73
Do	do	Oct. 3	89	14.5	9.4	1.47
Do	do	Oct. 3	90	15.0	9.5	1.78
Means				15.6	10.5	1.28
Rio Blanco	107, Brix 21, Oct. 7	Oct. 4	91	15.5	9.4	4.04
Do	do	Oct. 4	92	12.5	8.1	3.55
Do	do	Oct. 4	93	16.0	10.0	3.98
Do	do	Oct. 4	94	13.0	8.7	3.34
Do	do	Oct. 4	95	13.5	7.5	3.93
Do	do	Oct. 4	96	12.5	6.5	3.69
Do	do	Oct. 4	97	9.0	3.7	3.93
Do	do	Oct. 4	98	13.0	7.3	4.04
Do	do	Oct. 4	99	14.0	8.8	3.57
Do	do	Oct. 4	100	13.5	7.9	4.21
Means				13.3	7.8	3.83
Rio Blanco	107, Brix 20, Oct. 9	Oct. 4	101	14.5	9.4	2.92
Do	do	Oct. 4	102	16.5	11.4	4.00
Do	do	Oct. 4	103	13.5	8.9	2.83
Do	do	Oct. 4	104	16.5	11.7	2.90
Do	do	Oct. 4	105	15.5	10.0	4.11
Do	do	Oct. 4	106	14.5	9.8	3.36
Do	do	Oct. 4	107	15.0	10.4	3.12
Do	do	Oct. 4	108	16.5	11.8	3.18
Do	do	Oct. 4	109	13.0	7.5	3.39
Do	do	Oct. 4	110	16.5	11.5	3.71
Means				15.2	9.2	3.45
India and Orange	289, Brix 21, Oct. 11	Oct. 4	111	15.5	10.7	2.29
Do	do	Oct. 4	112	14.5	9.5	2.95
Do	do	Oct. 4	113	15.5	10.5	2.84
Do	do	Oct. 4	114	15.5	10.8	3.24
Do	do	Oct. 4	115	16.5	12.1	2.34
Do	do	Oct. 6	116	13.0	6.8	2.34
Do	do	Oct. 6	117	13.0	7.6	2.65
Do	do	Oct. 6	118	15.0	10.1	2.97
Do	do	Oct. 6	119	12.5	7.1	3.16
Do	do	Oct. 6	120	15.5	11.1	3.18
Means				14.7	9.6	2.90
India and Orange	289, 14175, sucrose 16.42, Oct. 26	Oct. 6	121	18.0	12.4	3.21
Do	do	Oct. 6	122	14.5	9.0	2.42
Do	do	Oct. 6	123	15.0	10.4	3.04
Do	do	Oct. 6	124	10.0	4.0	3.16
Do	do	Oct. 6	125	18.0	13.0	1.73
Do	do	Oct. 6	126	18.5	11.5	2.47
Do	do	Oct. 6	127	17.5	10.9	3.33
Do	do	Oct. 6	128	11.0	4.2	3.41
Do	do	Oct. 6	129	18.0	12.2	3.56
Do	do	Oct. 6	130	18.0	12.9	1.61
Means				15.9	10.1	2.79

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose	Glucose.
				Per cent.	*Per cent*	*Per cent.*
Pettus		Oct. 6	131	Worthless.		
Do		Oct. 6	132			
Do		Oct. 6	133			
Do		Oct. 6	134			
Do		Oct. 6	135			
Do		Oct. 6	136			
Do		Oct. 6	137			
Do		Oct. 6	138			
Do		Oct. 6	139			
Do		Oct. 6	140			
Var. of Honduras	112, 12677, sucrose 16.72, Oct. 8	Oct. 7	141	12.5	7.6	2.18
Do	do	Oct. 7	142	11.0	6.3	1.44
Do	do	Oct. 7	143	15.0	10.9	1.20
Do	do	Oct. 7	144	10.5	4.8	3.46
Do	do	Oct. 7	145	10.0	3.7	2.76
Do	do	Oct. 7	146	11.0	4.7	3.80
Do	do	Oct. 7	147	11.0	5.0	2.70
Do	do	Oct. 7	148	14.0	9.7	1.14
Do	do	Oct. 7	149	13.0	8.1	2.00
Do	do	Oct. 7	150	9.5	3.2	3.58
Means				11.8	6.4	2.43
Bicolor	259, 13799, sucrose 13.25, Oct. 23	Oct. 7	151	15.0	9.2	1.26
Do	do	Oct. 7	152	13.0	7.7	1.10
Do	do	Oct. 7	153	12.5	6.5	1.13
Do	do	Oct. 7	154	17.5	12.2	.97
Do	do	Oct. 7	155	12.0	7.2	1.33
Do	do	Oct. 7	156	17.0	12.2	.83
Do	do	Oct. 7	157	Worthless.		
Do	do	Oct. 7	158	16.5	9.0	.75
Do	do	Oct. 7	159	11.5	6.5	1.44
Do	do	Oct. 7	160	13.5	5.2	.91
Means				14.3	8.4	1.08
Bicolor	231, Brix 19, Oct. 5	Oct. 7	161	15.5	11.2	1.13
Do	do	Oct. 7	162	11.0	4.2	1.83
Do	do	Oct. 7	163	12.0	7.6	1.53
Do	do	Oct. 7	164	10.5	5.4	2.21
Do	do	Oct. 7	165	10.5	5.4	1.81
Do	do	Oct. 8	166	10.0	3.9	1.73
Do	do	Oct. 8	167	8.5	2.4	2.30
Do	do	Oct. 8	168	8.0	2.2	2.36
Do	do	Oct. 8	169	9.0	3.5	2.12
Do	do	Oct. 8	170	12.5	7.8	2.46
Means				10.8	6.4	1.95
Ubehlana	226, Brix 18, Oct. 26	Oct. 8	171	14.0	8.0	3.16
Do	do	Oct. 8	172	14.0	7.2	3.92
Do	do	Oct. 8	173	14.0	7.6	3.95
Do	do	Oct. 8	174	13.0	5.7	4.06
Do	do	Oct. 8	175	15.5	10.0	2.63
Do	do	Oct. 8	176	15.0	8.6	2.78
Do	do	Oct. 8	177	12.0	6.1	3.73
Do	do	Oct. 8	178	13.0	4.8	3.50
Do	do	Oct. 8	179	12.0	5.8	3.73
Do	do	Oct. 8	180	16.0	9.0	3.39
Means				13.9	7.3	3.49
Amber and Orange	293, Brix 21, Oct. 9	Oct. 8	181	16.0	8.0	2.59
Do	do	Oct. 8	182	14.5	8.3	2.24
Do	do	Oct. 8	183	17.0	13.1	1.08
Do	do	Oct. 8	184	16.0	7.3	1.77
Do	do	Oct. 8	185	16.5	12.2	1.31
Do	do	Oct. 8	186	17.0	12.9	1.60
Do	do	Oct. 8	187	17.5	11.6	1.06
Do	do	Oct. 8	188	14.0	8.5	2.34
Do	do	Oct. 8	189	18.0	12.3	1.03
Do	do	Oct. 8	190	16.0	11.5	1.87
Means				16.3	10.6	1.69

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Amber and Orange.	293, Brix 22.5, Oct. 10	Oct. 9	191	19.0	12.9	1.00
Do	do	Oct. 9	192	19.0	15.0	1.04
Do	do	Oct. 9	193	18.0	12.3	.79
Do	do	Oct. 9	194	19.0	14.0	.76
Do	do	Oct. 9	195	17.5	12.6	1.03
Do	do	Oct. 9	196	19.0	13.6	.99
Do	do	Oct. 9	197	18.0	13.6	.98
Do	do	Oct. 9	198	18.0	12.6	.73
Do	do	Oct. 9	199	19.5	13.4	.88
Do	do	Oct. 9	200	18.0	13.0	.69
Means				18.5	13.3	.89
Amber and Orange.	293, Brix 21.5, Oct. 12	Oct. 9	201	18.5	11.7	.95
Do	do	Oct. 9	202	19.5	12.3	.86
Do	do	Oct. 9	203	17.0	11.5	1.01
Do	do	Oct. 9	204	18.6	12.7	1.43
Do	do	Oct. 9	205	19.0	11.8	1.28
Do	do	Oct. 9	206	15.0	8.7	1.35
Do	do	Oct. 9	207	19.5	14.4	1.02
Do	do	Oct. 9	208	17.0	11.6	1.11
Do	do	Oct. 9	209	16.0	10.0	1.48
Do	do	Oct. 9	210	17.0	11.5	1.48
Means				17.7	11.6	1.16
Link's Hybrid	162, Brix 19, Sept. 25	Oct. 9	211	14.0	9.9	1.49
Do	do	Oct. 9	212	14.5	11.3	.88
Do	do	Oct. 9	213	11.5	7.0	1.81
Do	do	Oct. 9	214	16.0	12.2	1.02
Do	do	Oct. 9	215	14.0	11.0	1.12
Do	do	Oct. 10	216	14.5	9.7	1.87
Do	do	Oct. 10	217	14.5	9.8	1.77
Do	do	Oct. 10	218	12.0	7.3	1.82
Do	do	Oct. 10	219	15.5	11.4	1.30
Do	do	Oct. 10	220	14.5	10.5	1.26
Means				14.1	10.0	1.43
Link's Hybrid	162, Brix 19.5, Oct. 1	Oct. 10	221	15.0	9.5	2.96
Do	do	Oct. 10	222	16.0	10.5	2.53
Do	do	Oct. 10	223	14.0	8.7	2.44
Do	do	Oct. 10	224	16.5	10.8	3.44
Do	do	Oct. 10	225	16.5	12.1	1.59
Do	do	Oct. 10	226	17.0	11.3	3.00
Do	do	Oct. 10	227	10.0	3.9	4.00
Do	do	Oct. 10	228	16.0	12.6	.96
Do	do	Oct. 10	229	13.0	8.1	2.65
Do	do	Oct. 10	230	13.5	8.4	2.18
Means				14.8	9.6	2.57
Link's Hybrid	154, Brix 21, Oct. 8	Oct. 10	231	16.0	11.3	1.92
Do	do	Oct. 10	232	17.0	12.1	1.27
Do	do	Oct. 10	233	17.0	12.7	1.00
Do	do	Oct. 10	234	16.5	12.2	1.10
Do	do	Oct. 10	235	15.0	10.5	1.91
Do	do	Oct. 10	236	18.0	10.7	1.02
Do	do	Oct. 10	237	15.5	11.0	1.62
Do	do	Oct. 10	238	18.0	13.3	1.30
Do	do	Oct. 10	239	18.0	13.3	1.02
Do	do	Oct. 10	240	13.5	8.9	2.31
Means				16.5	11.6	1.45
Link's Hybrid	194, 11586, sucrose 16.01, glucose 0.53, Sept. 28.	Oct. 11	241	13.0	5.0	4.78
Do	do	Oct. 11	242	14.0	6.5	4.85
Do	do	Oct. 11	243	16.0	9.4	4.05
Do	do	Oct. 11	244	13.5	6.8	3.61
Do	do	Oct. 11	245	15.0	7.1	5.31
Do	do	Oct. 11	246	15.0	8.2	4.71
Do	do	Oct. 11	247	16.0	10.3	3.07
Do	do	Oct. 11	248	15.0	8.2	4.25
Do	do	Oct. 11	249	13.5	5.4	4.85
Do	do	Oct. 11	250	16.0	9.3	3.89
Means				14.7	7.6	4.34

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Red Liberian	134, 13631, sucrose 13.52, Oct. 21	Oct. 11	251	13.0	5.0	1.32
Do	do	Oct. 11	252	13.5	5.8	2.70
Do	do	Oct. 11	253	15.0	10.1	2.60
Do	do	Oct. 11	254	15.0	8.2	2.15
Do	do	Oct. 11	255	16.0	11.0	1.37
Do	do	Oct. 11	256	14.5	9.0	1.58
Do	do	Oct. 11	257	13.0	8.3	1.63
Do	do	Oct. 11	258	16.0	9.1	2.30
Do	do	Oct. 11	259	13.0	7.5	2.04
Do	do	Oct. 11	260	15.0	10.5	1.70
Means				14.4	8.5	1.88
Red Liberian	138, 13655, sucrose 13.97	Oct. 11	261	13.5	6.3	4.63
Do	do	Oct. 11	262	16.0	9.1	3.98
Do	do	Oct. 11	263	15.0	5.9	5.46
Do	do	Oct. 11	264	15.5	7.9	4.23
Do	do	Oct. 11	265	15.0	7.3	2.35
Do	do	Oct. 13	266	16.0	9.3	4.38
Do	do	Oct. 13	267	10.5	2.7	5.55
Do	do	Oct. 13	268	11.0	3.0	5.40
Do	do	Oct. 13	269	11.5	4.1	5.07
Do	do	Oct. 13	270	12.5	6.5	4.76
Means				13.7	6.2	4.58
Red Liberian	146, Brix 19, Oct. 22	Oct. 13	271	12.5	6.6	3.61
Do	do	Oct. 13	272	12.5	5.0	4.92
Do	do	Oct. 13	273	13.0	5.0	5.00
Do	do	Oct. 13	274	17.0	9.2	4.42
Do	do	Oct. 13	275	18.0	12.0	2.67
Do	do	Oct. 13	276	11.5	3.8	5.20
Do	do	Oct. 13	277	11.5	4.1	4.80
Do	do	Oct. 13	278	10.0	3.3	5.00
Do	do	Oct. 13	279	13.0	6.2	5.05
Do	do	Oct. 13	280	15.0	6.3	4.83
Means				13.4	6.2	4.55
Red Liberian	146, Brix 18.5	Oct. 13	281	16.5	9.4	3.77
Do	do	Oct. 13	282	13.0	6.4	5.49
Do	do	Oct. 13	283	16.5	7.9	4.00
Do	do	Oct. 13	284	12.5	5.5	4.63
Do	do	Oct. 13	285	13.5	7.0	4.36
Do	do	Oct. 13	286	14.0	6.1	4.83
Do	do	Oct. 13	287	13.5	4.9	5.68
Do	do	Oct. 13	288	14.0	6.4	5.31
Do	do	Oct. 13	289	15.5	8.5	3.85
Do	do	Oct. 13	290	15.0	7.3	4.13
Means				14.4	6.9	4.61
Red Liberian	127, Brix 19.5	Oct. 14	291	12.5	4.6	3.93
Do	do	Oct. 14	292	12.5	3.3	6.25
Do	do	Oct. 14	293	13.5	4.4	4.52
Do	do	Oct. 14	294	12.5	3.8	3.70
Do	do	Oct. 14	295	13.0	4.4	3.45
Do	do	Oct. 14	296	13.0	5.2	3.85
Do	do	Oct. 14	297	12.5	3.4	3.50
Do	do	Oct. 14	298	13.5	5.9	3.53
Do	do	Oct. 14	299	12.5	3.6	3.57
Do	do	Oct. 14	300	15.0	5.9	5.84
Means				13.1	4.5	4.21
Red Liberian	127, Brix 19.5	Oct. 14	301	14.0	5.9	5.46
Do	do	Oct. 14	302	14.5	6.1	5.34
Do	do	Oct. 14	303	15.5	8.0	4.54
Do	do	Oct. 14	304	17.0	11.0	3.57
Do	do	Oct. 14	305	17.5	10.6	4.25
Do	do	Oct. 14	306	16.0	8.9	4.46
Do	do	Oct. 14	307	17.5	10.8	4.35
Do	do	Oct. 14	308	17.0	9.1	4.09
Do	do	Oct. 14	309	18.0	9.1	3.53
Do	do	Oct. 14	310	16.0	9.7	3.59
Means				16.3	8.9	4.32

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Undendebule	31, Brix 20, Oct. 4	Oct. 14	311	12.0	6.4	2.07
Do	do	Oct. 14	312	16.0	10.5	1.23
Do	do	Oct. 14	313	18.0	10.0	2.08
Do	do	Oct. 14	314	17.0	12.1	1.32
Do	do	Oct. 14	315	14.0	8.3	2.59
Do	do	Oct. 15	316	15.5	9.1	2.78
Do	do	Oct. 15	317	15.0	9.5	2.25
Do	do	Oct. 15	318	16.0	10.7	2.16
Do	do	Oct. 15	319	15.0	9.8	2.84
Do	do	Oct. 15	320	14.0	7.6	2.12
Means				15.3	9.4	2.14
Rio Blanco	107, Brix 21, Oct. 7	Oct. 15	321	17.5	11.9	2.78
Do	do	Oct. 15	322	16.5	10.3	2.36
Do	do	Oct. 15	323	18.0	13.1	2.38
Do	do	Oct. 15	324	18.0	11.4	2.59
Do	do	Oct. 15	325	18.0	12.7	2.06
Do	do	Oct. 15	326	16.5	11.5	2.35
Do	do	Oct. 15	327	16.0	10.8	2.53
Do	do	Oct. 15	328	17.0	10.1	3.58
Do	do	Oct. 15	329	17.0	11.3	2.73
Do	do	Oct. 15	330	18.0	7.7	2.49
Means				17.3	10.1	2.59
Var. of Honduras	112, Brix 19, Sept. 24	Oct. 15	331	17.5	12.5	.75
Do	do	Oct. 15	332	16.5	11.7	.90
Do	do	Oct. 15	333	16.5	11.7	.84
Do	do	Oct. 15	334	16.5	11.9	.92
Do	do	Oct. 15	335	18.0	13.2	.66
Do	do	Oct. 15	336	17.5	12.2	.91
Do	do	Oct. 15	337	16.0	10.8	.92
Do	do	Oct. 15	338	16.5	11.7	.82
Do	do	Oct. 15	339	17.5	13.0	.98
Do	do	Oct. 15	340	16.5	11.9	.77
Means				16.9	12.1	.85
India and Orange	289, Brix 19, Oct. 26	Oct. 16	341	13.5	7.7	2.42
Do	do	Oct. 16	342	17.5	12.7	1.08
Do	do	Oct. 16	343	17.5	11.8	1.24
Do	do	Oct. 16	344	15.0	10.0	1.96
Do	do	Oct. 16	345	16.5	10.7	1.96
Do	do	Oct. 16	346	14.5	8.8	2.47
Do	do	Oct. 16	347	17.5	12.5	.71
Do	do	Oct. 16	348	17.5	13.2	.59
Do	do	Oct. 16	349	18.0	12.1	1.34
Do	do	Oct. 16	350	18.5	13.3	.87
Means				16.6	11.3	1.46
Var. of Honduras	112, Brix 21, Oct. 8	Oct. 16	351	16.5	11.6	.94
Do	do	Oct. 16	352	16.0	11.5	1.30
Do	do	Oct. 16	353	16.5	10.0	1.18
Do	do	Oct. 16	354	17.5	11.4	1.13
Do	do	Oct. 16	355	14.5	5.9	1.39
Do	do	Oct. 16	356	15.0	10.7	1.05
Do	do	Oct. 16	357	15.5	11.2	1.40
Do	do	Oct. 16	358	17.0	12.5	.97
Do	do	Oct. 16	359	16.0	10.9	.87
Do	do	Oct. 16	360	17.5	12.4	1.04
Means				16.2	10.8	1.03
Bicolor	259, Brix 18, Oct. 4	Oct. 16	361	17.5	11.8	.76
Do	do	Oct. 16	362	18.0	12.3	.81
Do	do	Oct. 16	363	17.0	11.4	.95
Do	do	Oct. 16	364	17.5	12.7	.82
Do	do	Oct. 16	365	17.0	12.3	.75
Do	do	Oct. 17	366	17.5	12.7	.64
Do	do	Oct. 17	367	18.0	13.2	.74
Do	do	Oct. 17	368	18.0	13.4	.62
Do	do	Oct. 17	369	17.5	12.6	.70
Do	do	Oct. 17	370	17.5	12.5	.59
Means				17.6	12.5	.74

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solid.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Amber and Orange	293, 13927, cane sugar 15.85, Oct. 24.	Oct. 17	371	20.0	15.1	.26
Do	....do	Oct. 17	372	18.5	13.6	.81
Do	... do	Oct. 17	373	19.0	14.2	.62
Do	....do	Oct. 17	374	18.5	11.9	1.64
Do	....do	Oct. 17	375	18.0	13.5	1.50
Do	....do	Oct. 17	376	18.5	13.5	.83
Do	....do	Oct. 17	377	17.5	11.9	1.36
Do	....do	Oct. 17	378	19.5	14.1	.72
Do	....do	Oct. 17	379	18.5	13.7	.80
Do	....do	Oct. 17	380	19.0	12.9	.71
Means				18.7	13.4	.88
Link's Hybrid	167, Brix 19, Oct. 23	Oct. 17	381	17.0	11.4	1.15
Do	....do	Oct. 17	382	16.5	12.1	.96
Do	... do	Oct. 17	383	16.5	11.8	1.33
Do	....do	Oct. 17	384	18.0	13.7	1.00
Do	....do	Oct. 17	385	16.0	11.3	1.47
Do	....do	Oct. 17	386	14.0	9.0	2.37
Do	....do	Oct. 17	387	16.0	11.5	1.56
Do	....do	Oct. 17	388	13.5	8.8	2.08
Do	....do	Oct. 17	389	15.0	10.5	1.61
Do	....do	Oct. 17	390	17.0	12.9	.71
Means				16.0	11.3	1.42
Link's Hybrid	162, Brix 20, Sept. 25	Oct. 18	391	17.5	12.7	1.72
Do	....do	Oct. 18	392	16.5	11.3	1.67
Do	....do	Oct. 18	393	16.5	11.4	1.57
Do	....do	Oct. 18	394	17.5	13.2	1.04
Do	....do	Oct. 18	395	16.5	12.1	1.54
Do	....do	Oct. 18	396	13.5	8.5	1.47
Do	... do	Oct. 18	397	16.0	11.1	1.64
Do	....do	Oct. 18	398	17.0	12.8	1.07
Do	....do	Oct. 18	399	18.0	13.1	.79
Do	... do	Oct. 18	400	18.5	14.3	.58
Means				16.8	12.1	1.31
Link's Hybrid	162, Brix 21, Oct. 1	Oct. 18	401	17.0	11.7	1.57
Do	....do	Oct. 18	402	16.5	11.7	1.60
Do	....do	Oct. 18	403	19.0	14.4	.81
Do	....do	Oct. 18	404	15.0	9.5	1.85
Do	....do	Oct. 18	405	16.5	12.0	1.23
Do	....do	Oct. 18	406	17.5	13.1	.97
Do	....do	Oct. 18	407	17.0	12.6	1.37
Do	....do	Oct. 18	408	19.0	14.6	.58
Do	....do	Oct. 18	409	18.0	13.7	.55
Do	....do	Oct. 18	410	15.0	10.0	1.47
Means				17.1	12.3	1.20
Link's Hybrid	165, 11491, sucrose 16.69	Oct. 18	411	18.5	13.8	1.17
Do	....do	Oct. 18	412	19.0	15.0	.68
Do	....do	Oct. 18	413	19.0	12.6	1.05
Do	....do	Oct. 18	414	18.0	13.4	1.46
Do	....do	Oct. 18	415	18.0	14.3	1.05
Do	....do	Oct. 20	416	18.0	13.8	.80
Do	....do	Oct. 20	417	18.5	13.6	.88
Do	....do	Oct. 20	418	19.0	14.1	1.03
Do	... do	Oct. 20	419	17.5	12.2	2.08
Do	....do	Oct. 20	420	18.0	12.8	1.30
Means				18.4	13.6	1.15
Link's Hybrid	194, 13897, sucrose 15.66, Oct. 24	Oct. 20	421	15.0	8.6	2.19
Do	....do	Oct. 20	422	15.5	9.5	2.20
Do	... do	Oct. 20	423	16.0	10.6	1.81
Do	....do	Oct. 20	424	19.5	14.0	1.43
Do	... do	Oct. 20	425	16.5	11.5	1.32
Do	....do	Oct. 20	426	18.5	13.5	.92
Do	....do	Oct. 20	427	14.5	8.8	2.07
Do	....do	Oct. 20	428	18.5	14.5	1.00
Do	....do	Oct. 20	429	18.5	14.1	1.22
Do	....do	Oct. 20	430	17.0	11.3	1.05
Means				17.0	11.6	1.52

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Link's Hybrid	194, 11558, sucrose 16.21, Sept. 28	Oct. 20	431	15.0	9.8	1.56
Do	do	Oct. 20	432	15.5	9.8	1.49
Do	do	Oct. 20	433	16.5	11.3	1.71
Do	do	Oct. 20	434	14.5	8.7	2.21
Do	do	Oct. 20	435	14.0	8.6	1.76
Do	do	Oct. 20	436	14.0	8.3	1.71
Do	do	Oct. 20	437	15.5	10.3	1.56
Do	do	Oct. 20	438	14.0	8.6	1.68
Do	do	Oct. 20	439	14.5	9.1	2.41
Do	do	Oct. 20	440	16.0	11 1	1.55
Means				15.0	9.6	1.76
Link's Hybrid	162, 13379, Brix 20, Sept. 25	Oct. 21	441	15.0	10.0	1.69
Do	do	Oct. 21	442	15.0	9.9	2.25
Do	do	Oct. 21	443	14.5	8.0	3.20
Do	do	Oct. 21	444	14.5	8.7	2.97
Do	do	Oct. 21	445	15.0	9.1	2.48
Do	do	Oct. 21	446	15.0	9.0	2.45
Do	do	Oct. 21	447	16.0	10.7	2.00
Do	do	Oct. 21	448	15.0	9.4	2.25
Do	do	Oct. 21	449	15.5	10.1	2.23
Do	do	Oct. 21	450	15.5	10.5	2.71
Means				15.1	9.5	2.42
Link's Hybrid	194, 11585, sucrose 15.80, Sept. 28	Oct. 21	451	16.5	11.6	2.78
Do	do	Oct. 21	452	17.5	11.8	2.63
Do	do	Oct. 21	453	17.0	11.7	2.50
Do	do	Oct. 21	454	16.5	10.3	2.74
Do	do	Oct. 21	455	17.0	11.1	2.61
Do	do	Oct. 21	456	18.0	12.6	2.24
Do	do	Oct. 21	457	18.0	12.6	1.98
Do	do	Oct. 21	458	16.5	10.6	2.31
Do	do	Oct. 21	459	17.5	12.7	2.02
Do	do	Oct. 21	460	16.5	11.6	2.24
Means				17.1	11.7	2.41
Link's Hybrid	164, Brix 19.5, Sept. 28	Oct. 21	461	16.0	10.6	1.95
Do	do	Oct. 21	462	15.5	10.0	2.19
Do	do	Oct. 21	463	15.0	9.6	2.36
Do	do	Oct. 21	464	14.0	8.5	2.22
Do	do	Oct. 21	465	14.0	8.5	2.68
Means				14.9	9.4	2.28
Amber and Orange	293, 12142, sucrose 17.99, Oct. 3	Oct. 25	466	19.0	14.3	1.21
Do	do	Oct. 25	467	18.5	14.2	1.59
Do	do	Oct. 25	468	18.0	13.4	2.73
Do	do	Oct. 25	469	17.5	13.5	1.74
Do	do	Oct. 25	470	16.5	11.9	2.15
Means				17.9	13.5	1.89
Amber and Orange	293, 13389, cane sugar 17.70, Oct. 12	Oct. 25	471	18.0	13.6	1.83
Do	do	Oct. 25	472	17.0	12.9	2.01
Do	do	Oct. 25	473	17.5	12.3	2.62
Do	do	Oct. 25	474	19.0	14.5	1.60
Do	do	Oct. 25	475	19.5	15.5	1.33
Means				18.2	13.8	1.88
Amber and Orange	293, 12132, sucrose 17.99, Oct. 31	Oct. 25	476	18.0	13.7	.81
Do	do	Oct. 25	477	16.5	12.0	1.87
Do	do	Oct. 25	478	18.0	13.9	.71
Do	do	Oct. 25	479	16.5	12.2	1.04
Do	do	Oct. 25	480	14.5	10.7	1.40
Means				16.7	12.5	1.17
Amber and Orange	293, 13398, cane sugar 17.62, Oct. 12	Oct. 25	481	17.0	13.5	1.00
Do	do	Oct. 25	482	18.5	14.4	1.24
Do	do	Oct. 25	483	18.0	12.6	1.41
Do	do	Oct. 25	484	16.0	12.3	1.55
Do	do	Oct. 25	485	16.5	12.3	1.64
Means				17.2	13.0	1.37

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Bicolor	51, Brix 19, Oct. 4	Oct. 25	486	12.5	8.5	1.39
Do	do	Oct. 25	487	13.5	9.2	1.10
Do	do	Oct. 25	488	15.5	11.1	1.69
Do	do	Oct. 25	489	13.5	9.4	1.59
Do	do	Oct. 25	490	14.5	10.0	1.82
Means				13.9	9.6	1.50
Var. of Honduras	112, Brix 19, Sept. 23	Oct. 27	491	9.5	2.5	4.76
Do	do	Oct. 27	492	10.5	6.1	2.44
Do	do	Oct. 27	493	10.0	5.2	2.97
Do	do	Oct. 27	494	10.5	5.4	2.87
Do	do	Oct. 27	495	16.5	12.5	1.06
Means				11.4	6.3	2.82
Var. of Honduras	112, Brix 19, Oct. 8	Oct. 27	496	14.0	10.1	1.43
Do	do	Oct. 27	497	12.5	7.4	1.54
Do	do	Oct. 27	498	10.5	5.4	2.78
Do	do	Oct. 27	499	9.0	2.0	4.25
Do	do	Oct. 27	500	9.0	2.0	4.73
Means				11.0	5.4	2.95
Var. of Honduras	112, Brix 20, Oct. 8	Oct. 27	501	11.5	6.6	2.57
Do	do	Oct. 27	502	13.5	7.0	4.13
Do	do	Oct. 27	503	14.0	10.1	.92
Do	do	Oct. 27	504	13.5	8.8	2.63
Do	do	Oct. 27	505	12.0	5.0	4.31
Means				12.9	7.5	2.91
Var. of Honduras	112, 12687, sucrose 16.75, Oct. 8	Oct. 27	506	13.5	8.3	2.93
Do	do	Oct. 27	507	10.0	5.9	1.79
Do	do	Oct. 27	508	16.0	12.1	1.55
Do	do	Oct. 27	509	16.5	12.1	1.47
Do	do	Oct. 27	610	15.0	11.0	.90
Means				14.2	9.9	1.73
India and Orange	289, 13214, sucrose 17.31, Oct. 10	Oct. 27	511	14.5	10.1	2.52
Do	do	Oct. 27	512	19.0	14.6	.95
Do	do	Oct. 27	513	13.0	7.9	3.66
Do	do	Oct. 27	514	16.5	12.2	2.02
Do	do	Oct. 27	515	13.5	8.5	2.65
Means				15.3	10.7	2.36
Undendebule	254, 12475, sucrose 17.86, glucose 0.46	Oct. 28	516	19.0	14.0	.65
Do	do	Oct. 28	217	15.0	10.8	.92
Do	do	Oct. 28	518	15.0	10.4	1.02
Do	do	Oct. 28	519	15.5	11.1	1.14
Do	do	Oct. 28	520	18.5	13.9	.59
Means				16.6	12.1	.86
Undendebule	254, 13133, sucrose 18.24	Oct. 28	521	13.5	9.4	.98
Do	do	Oct. 28	522	14.5	10.0	1.43
Do	do	Oct. 28	523	18.0	13.7	1.62
Do	do	Oct. 28	524	15.0	11.4	1.39
Do	do	Oct. 28	525	19.0	14.6	.53
Means				16.0	11.8	1.18
Undendebule	254, 13336, sucrose 17.37, glucose 0.91	Oct. 28	526	17.5	13.8	.53
Do	do	Oct. 28	527	19.0	15.8	.46
Do	do	Oct. 28	528	20.5	16.4	.50
Do	do	Oct. 28	529	17.5	13.3	.85
Do	do	Oct. 28	530	19.0	14.7	.50
Means				18.7	14.8	.57
Undendebule	254, 13127, sucrose 17.72, glucose 0.89	Oct. 28	531	18.0	13.5	.49
Do	do	Oct. 28	532	16.5	12.7	.73
Do	do	Oct. 28	533	10.5	5.4	2.17
Do	do	Oct. 28	534	8.5	4.1	2.24
Do	do	Oct. 28	535	17.0	12.5	.97
Means				14.1	9.6	1.32

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Red Liberian	141, 13720, sucrose 14.73	Oct. 28	536	16.0	8.8	4.35
Do	do	Oct. 28	537	14.0	7.0	4.20
Do	do	Oct. 28	538	11.0	3.8	4.78
Do	do	Oct. 28	539	14.0	7.0	4.38
Do	do	Oct. 28	540	12.5	5.9	4.29
Means				13.5	6.3	4.40
Red Liberian	135, Brix 19	Oct. 29	541	12.5	4.7	5.81
Do	do	Oct. 29	542	12.5	7.0	3.85
Do	do	Oct. 29	542	11.0	4.3	4.71
Do	do	Oct. 29	544	12.5	6.4	4.17
Do	do	Oct. 29	545	12.5	3.7	6.02
Means				12.2	5.2	4.91
Red Liberian	138, Brix 18.5, Oct. 21	Oct. 29	546	13.5	5.3	5.81
Do	do	Oct. 29	547	12.5	4.8	4.06
Do	do	Oct. 29	548	13.5	5.9	5.26
Do	do	Oct. 29	549	14.5	6.1	4.50
Do	do	Oct. 29	550	13.5	6.5	4.35
Means				13.5	5.7	5.00
Red Liberian	128, 13300, cane sugar 14.84	Oct. 29	551	16.0	8.8	4.58
Do	do	Oct. 29	552	11.0	2.0	6.02
Do	do	Oct. 29	553	16.0	8.6	4.85
Do	do	Oct. 29	554	13.5	5.7	6.25
Do	do	Oct. 29	555	14.5	6.2	6.25
Means				14.2	6.3	5.59
Red Liberian	130, 13647, sucrose 14.09	Oct. 29	556	13.5	3.4	6.67
Do	do	Oct. 29	557	12.5	2.0	7.24
Do	do	Oct. 29	558	11.0	2.7	6.59
Do	do	Oct. 29	559	12.5	2.0	7.69
Do	do	Oct. 29	560	16.0	7.6	5.81
Do	do	Oct. 29	561	12.5	3.3	5.71
Do	do	Oct. 29	562	14.5	6.7	5.37
Do	do	Oct. 29	563	13.5	5.5	6.32
Do	do	Oct. 29	564	13.5	6.4	5.61
Means				13.3	4.4	6.33
Red Liberian	137, Brix 19, Oct. 25	Oct. 31	565	16.0	7.3	5.55
Do	do	Oct. 31	566	16.0	9.6	3.85
Do	do	Oct. 31	567	16.0	7.9	4.76
Means				16.0	8.3	4.72
Red Liberian	138, Brix 18, Oct. 21	Oct. 31	568	15.0	6.8	4.35
Do	do	Oct. 31	569	12.5	5.4	4.35
Do	do	Oct. 31	570	12.5	6.1	4.42
Means				13.3	6.1	4.37
Red Liberian	125, 13254, sucrose 15.04, Oct. 11	Oct. 31	571	13.5	8.5	3.85
Do	do	Oct. 31	572	16.0	6.4	4.76
Do	do	Oct. 31	573	16.0	6.4	5.00
Means				15.2	7.1	4.54
Red Liberian	135, Brix 18	Oct. 31	574	16.0	6.9	4.17
Do	do	Oct. 31	575	12.5	3.9	4.20
Do	do	Oct. 31	576	13.5	4.8	6.25
Means				14.0	5.2	4.87
Red Liberian	125, 13258, sucrose 14.81	Oct. 31	577	13.5	4.8	5.55
Do	do	Oct. 31	578	13.5	3.0	5.55
Do	do	Oct. 31	579	16.0	7.1	5.55
Means				14.0	5.0	5.55

Variety.	Description of parent seed head.	Date.	No. of analysis.	In the juice.		
				Solids.	Sucrose.	Glucose.
				Per cent.	*Per cent.*	*Per cent.*
Red Liberian	127, Brix 19.5	Oct. 31	580	17.0	13.7	2.56
Do	....do	Oct. 31	581	20.5	13.9	1.50
Do	....do	Oct. 31	582	20.5	15.3	.66
Do	....do	Oct. 31	583	20.5	13.9	.69
Do	....do	Oct. 31	584	20.5	15.5	.74
Do	....do	Oct. 31	585	18.0	15.5	.95
Means				19.5	14.6	1.18
Amber and Orange.	293, 12142, sucrose, 17.99, Oct. 3	Oct. 31	586	19.5	15.0	1.01
Do	....do	Oct. 31	587	18.0	12.5	2.17
Do	....do	Oct. 31	588	18.0	13.8	1.72
Means				18.5	13.8	1.97

CULTURE EXPERIMENTS AT FORT SCOTT, KANSAS.

Culture experiments were carried on at Fort Scott, Kansas, during the summer of 1890, under the direction of Prof. J. C. Hart. The seeds used were pedigreed seeds, produced at the Department station at Sterling during the previous year. The general result was as follows:

The Early Amber variety showed a mean of 17.3 per cent of total solids in the juice, 13.2 per cent sugar, and a purity of 76.3.

The cross of Amber and Orange showed a mean of 18.7 per cent of total solids, 14.1 of sugar, with a purity of 75.2.

Folger's Early showed 18.4 solids, 13.5 sugar, 73.4 purity.

A cross of Amber and Link's Hybrid showed 18.4 total solids, 13.0 sugar, with a purity of 70.9.

Undendebule showed 18.9 total solids, 13.5 sugar, 71.2 purity.

A cross of India and Orange showed 17.4 total solids, 12.6 sugar, 72.6 purity.

Link's Hybrid gave 18.6 total solids, 13.1 sugar, 70.5 purity.

The character of the other varieties tested will be sufficiently shown in the following tables, which give the analytical details. The description of the parent seed head refers to the numbers in the pedigree book of the Department.

Analyses of selected canes.

EARLY AMBER.

Parent stalk.				Growth of 1890.			
Plot number at Sterling.	Date.	Per cent solids.	Per cent sucrose.	Date.	Per cent solids.	Per cent sucrose.	Purity.
	1889			1890			
235	Sept. 11		13.49	Aug. 25	17.5	13.65	78.0
				Aug. 25	17.0	13.20	77.6
				Aug. 25	18.0	14.1	78.3
				Aug. 25	17.8	14.1	79.2
				Aug. 25	16.2	12.1	74.7
				Aug. 25	18.3	14.0	76.5
				Aug. 25	16.5	11.7	71.0
				Aug. 14	16.0	12.9	80.6
				Aug. 16	18.5	13.85	75.0
				Aug. 16	17.7		
				Aug. 20	16.8	12.8	76.2
				Aug. 21	17.1	12.75	74.6
Means					17.3	13.2	76.3
Maxima					18.5	14.1	80.6
Minima					16.0	11.7	71.0

CROSS OF AMBER AND ORANGE.

293	Sept. 28		18.28	Sept. 6	18.6	15.0	80.6
				Sept. 6	19.0	14.05	74.0
				Sept. 9	18.7	14.05	75.1
				Sept. 13	17.5	13.1	74.3
				Sept. 13	18.5	13.4	72.4
				Sept. 13	18.3	13.35	73.0
				Sept. 13	19.2	14.8	77.1
				Sept. 13	18.5	13.25	71.6
				Sept. 18	18.2	14.0	76.8
				Sept. 18	17.8	13.87	78.0
				Sept. 19	18.8	13.95	74.2
				Sept. 19	19.6	16.1	83.4
				Sept. 20	18.8	13.8	73.4
				Sept. 20	18.1	13.9	76.8
				Sept. 20	18.6	14.75	79.3
				Sept. 20	19.0	14.8	77.9
293	Oct. 10	22.5		Sept. 26	17.8	12.2	74.1
				Oct. 14	21.44	15.6	72.7
293	Oct. 2	21.5		Oct. 24	18.9	12.3	65.1
Means					18.7	14.06	75.2
Maxima					21.44	16.1	83.4
Minima					17.5	12.3	65.1

FOLGER'S EARLY.

205		19.0		Sept. 9	18.0	12.8	71.0
				Sept. 9	17.7	12.15	68.6
				Sept. 9	18.7	12.85	68.7
				Sept. 9	18.5	12.8	69.2
				Sept. 9	19.3	13.8	71.5
				Aug. 25	17.5	12.75	72.8
				Sept. 1	18.5	13.75	74.3
				Sept. 1	19.1	14.5	76.0
				Sept. 1	19.1	15.0	78.5
				Sept. 3	19.0	14.7	77.3
				Sept 3	18.5	14.7	80.0
				Sept. 6	19.4	15.6	80.4
				Sept. 26	15.8	10.7	67.7
Means					18.4	13.5	73.4
Maxima					19.4	15.6	80.4
Minima					15.8	10.7	67.7

Analyses of sslected canes—Continued.

AMBER AND LINK'S HYBRID.

Parent tsalk.				Growth of 1890.			
Plot number at Sterling.	Date.	Per cent solids.	Per cent sucrose.	Date.	Per cent solids.	Per cent sucrose.	Purity
	1889			1890			
172	Oct. 24		15.24	Sept. 29	17.5	11.4	65.0
				Oct. 2	17.4	13.1	75.3
				Oct. 2	17.5	13.4	76.6
				Oct. 7	17.7	13.9	78.5
				Oct. 7	18.7	13.85	74.06
				Oct. 8	19.84	13.75	69.3
				Oct. 8	19.74	13.1	66.3
				Oct. 8	20.28	13.15	64.3
				Oct. 8	19.17	13.3	69.3
				Sept. 26	16.5	11.85	71.8
172	Oct. 2	19.5	16.19	Oct. 24	18.1	12.6	69.6
Means					18.4	13.0	70.9
Maxima					20.28	13.9	78.5
Minima					16.5	11.4	64.3

UNDENDEBULE.

254	Oct. 4	21.0		Sept. 13	18.8	13.0	69.1
				Sept. 13	16.5	10.9	66.0
				Sept. 29	18.8	12.6	67.0
				Oct. 2	19.1	14.75	77.2
				Oct. 2	18.5	13.8	74.6
				Oct. 7	18.8	14.65	78.0
254	Oct. 10	20.0		Oct. 26	21.53	14.50	67.3
Means					18.9	13.46	71.2
Maxima					21.53	14.75	78.0
Minima					16.5	10.9	66.0

INDIA AND ORANGE.

320	Oct. 25		15.35	Sept. 29	18.1	12.9	71.2
				Oct. 2	17.3	13.3	76.8
				Oct. 2	17.3	13.3	76.8
				Oct. 7	15.3	11.95	78.1
				Oct. 7	15.6	11.0	70.5
				Oct. 11	20.34	14.5	70.6
				Oct. 11	19.44	14.4	74.1
				Oct. 11	20.54	15.0	73.0
318	Oct. 25	19.0		Oct. 30	14.7	8.9	60.5
311	Oct. 25	18.0		Oct. 30	15.1	11.1	73.5
Means					17.4	12.64	72.6
Maxima					20.54	14.5	78.1
Minima					14.7	8.9	60.5

LINK'S HYBRID.

194	Oct. 24		15.38	Sept. 29	18.3	12.4	67.7
				Oct. 11	18.9	13.4	70.8
				Oct. 11	18.8	13.15	70.0
				Oct. 11	19.4	13.55	70.0
154	Oct. 8		17.56	Oct. 14	17.8	12.3	70.0
116	Oct. 8	20.5		Oct. 30	18.2	13.9	76.4
Means					18.6	13.12	70.5
Maxima					19.4	13.9	76.4
Minima					17.8	12.3	67.7

*Analyses of selected canes**—Continued.

CHINESE.

Parent stalk.				Growth of 1890.			
Plot number at Sterling.	Date.	Per cent solids.	Per cent sucrose.	Date.	Per cent solids.	Per cent sucrose.	Purity.
	1889.			1890.			
39	Oct. 24		13.3	Sept. 29	15.9	8.9	56.0
59	Oct. 25	17.0		Oct. 28	16.7	10.0	59.9
Means					16.3	9.45	57.9

MANZANA.

12	Sept. 26	20.0		Oct. 14	18.87	13.0	68.9
216	Oct. 10	19.0		Oct. 26	16.35	11.4	69.7
Means					17.6	12.2	69.3

BLACK AFRICAN.

109	Sept. 18		15.83	Sept. 26	16.1	11.3	70.0
				Oct. 27	13.4	8.2	61.2
				Oct. 28	17.97	12.6	70.0
Means					15.8	10.7	67.1
Maxima					17.97	12.6	70.0
Minima					13.4	8.2	61.2

HONDURAS.

120	Oct. 8	19.0		Oct. 12	16.7	11.5	68.9

LINK'S HYBRID AND LIBERIAN.

176	Nov. 2	21.0		Oct. 24	18.0	12.7	70.6

RED LIBERIAN.

126	Oct. 11	20.0		Oct. 24	17.0	9.0	52.9
				Oct. 30	15.5	8.1	52.3
Means					16.3	8.55	52.6

EARLY ORANGE.

239	Oct. 10	20.0		Oct. 27	16.8	11.2	66.6

SORGHUM BICOLOR.

396	Oct. 23	18.0		Oct. 30	15.33	11.3	73.7